

*SENSEMAKING AND HUMAN-CENTRED
DESIGN: A PRACTICE PERSPECTIVE*



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Five years ago I began a new life in a timeless place in search of, as the Cambridge motto puts it, enlightenment and sacred draughts. This turn in my journey followed an exhilarating, life changing and exhausting few years on the road, without fixed address, in Malawi and Kenya. I needed time for reflection and I found it here. I never shed my practitioner concerns and partnership with the good people of Medic Mobile, so it may have been inevitable that I would see only a part of Cambridge, as through a window, brightly. This was more than enough. With time for reading, writing and a fair few remarkable human beings, my imagination caught fire again. I won't always have the time for reflection that this place has afforded but I hope, like waking from a dream that fades yet leaves a residue, to take the sense of timelessness with me. Many people have made my life here remarkable, have made it possible, have been patient when I was too deep in my books to keep up with anything else—thank you.

This work owes countless debts to my family, an inspiring bunch of free thinking folk poets and farmers, inventors, war heroes and dissident intellectuals, fishers, athletes, teachers, tree cutters, mechanics, entrepreneurs and public servants whose story spans six generations in the rural reaches of the pacific northwest. Word, sentence and paragraph, the voice in my writing is a song I sing for my family.

The pages that follow also show more or less clearly that my writing and my design practice are one and the same adventure, head, hand and heart. I am grateful to the many partners at Medic Mobile who have made my small part in the movement for global health equity so fruitful. Dianna, Jacqueline, Josh, Katanu, Marc, Regina, countless community health workers and the good people of St. Gabriel's Hospital deserve special appreciation. I continue to believe that we are all health workers.

Claudia and the University of Edinburgh's Global Health Academy afforded my first major teaching experiences, inviting me to bridge my work experiences and scholarly interests in a way that has shaped my writing greatly. Thank you.

King's College, the Gates Scholar community and Cambridge: your libraries, chapel choir, formal hall and thousand charmed traditions have made for a remarkable intellectual and spiritual community. Michael for opening the door to my studies in digital innovation, Mark for being a fox in a hedgehog's world, Jen for teaching me to get back in the saddle—you've nurtured me more than I can say. To my fellow students Andrea, Andrew, Ben, Brianne, Halliki, Jorge, Katie, Kevin, Nick, Roderick, Tara, Toby, Victor—thank you for living the Cambridge motto in full form; you have been the lights and sacred draughts of my time here.

Finally, Tim, thank you for loving books long before I did; you're the reason I learned to read. Carlos, trying to understand your story sent me on this whole humanitarian journey. Above all Tara, for drinking from the same cup, for your sociomaterial partnership, I dedicate this work to you.

Hinc lucem et pocula sacra

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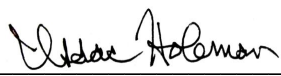
We are all health workers

DECLARATION

This dissertation is the result of my own work and includes nothing which is the outcome of work done in collaboration, except where specifically indicated in the text. For Chapters one, two and six I am the sole author. In Chapter Three I worked with one co-author (Michael Barrett) and performed approximately 75% of the work. In Chapter Four I worked with two co-authors (Mark de Rond, Jennifer Howard-Grenville) and performed approximately 50% of the work to produce the version in this dissertation. In Chapter Five my one co-author (Dianna Kane) is responsible for approximately 25% of the work and the remaining 75% is of my creation. Collectively, chapters two-five are 75% of my own creation and 25% the creation of co-authors, in keeping with expectations set forth in the Judge Business School PhD handbook.

This work has not been previously submitted, in part or whole, to any university or institution for any degree, diploma, or other qualification. As I note in the text, Chapter Three draws on data which I used to write a dissertation for the degree of Master of Philosophy, while studying in the University of Cambridge sociology department. More than two thirds of the data used in Chapter Three were gathered after my MPhil degree was conferred, the present text has been entirely re-written and the theories we engage and the analysis we develop are altogether different. For this reason no part of Chapter Three is substantially the same as work submitted for other degrees.

This dissertation is 75,796 words in length excluding bibliography but including tables, footnotes and appendices. This is in accordance with the Judge Business School Degree Committee Policy that PhD theses should not exceed 80,000 words.

Signed:  _____

Date: October 8th, 2017

Isaac Thomas Michael Holeman, MPhil

SENSEMAKING AND HUMAN-CENTRED DESIGN: A PRACTICE PERSPECTIVE

Isaac Thomas Michael Holeman

This dissertation explores how people address problems of real human concern in situations of complexity, ambiguity, uniqueness, conflicting values and rapid change. Such circumstances stretch formal and idealistic rules and procedures to the breaking point. And yet, people in a variety of fields work through such difficulties in a pragmatic manner, at times finding ways to assert their humanity. Sensemaking and human-centred design are related activities through which many people approach such work. Through cases in digital innovation, global health care delivery and an unlikely voyage of the Amazon River, this portfolio shows that they are relevant to a wide range of settings. Rather than isolating the components or key variables of such work and taking their measure, this research advances a more holistic view of sensemaking and designing as sociomaterial practices. My research is grounded in performing the phenomenon of study, offering insights from complex practice rather than a spectator's study of it. This ethnographic approach has yielded theoretical contributions related to designing for the emergence of practices, embodied sensemaking, a more substantive notion of what it means to be 'human' centred and more pragmatic ways of investigating sociomaterial practices. By discussing sensemaking and human-centred design as antidotes to failures of imagination in global health and development, this dissertation suggests a distinctive perspective on why these topics matter for the health of poor and marginalized people around the world.

Keywords: digital health, digital innovation, global health, human-centred design, ICT4D, imbrication, information systems, materiality, mHealth, organizational ethnography, practice theory, sensemaking, sociomaterial practices.

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LIST OF ABBREVIATIONS AND ACRONYMS

ADR – Action Design Research

HIV – Human Immunodeficiency Virus

ICT – Information and Communication Technology

ICT4D – Information and Communication Technology for Development

IS – Information System

mHealth – Mobile Health/mobile technology for health care

SMS – Short Message Service/Text Message

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1 INTRODUCTION

1.1 Discovering Digital Health

In the middle of 2009 I arrived for work in Malawi, a landlocked nation in southeast Africa that in colonial times was called Nyasaland. Though I did not know it yet, I would spend more than three years without a fixed address, partnering with many local healthcare organizations to make use of recent advances in mobile telecommunications infrastructure. These nomadic years were chaotic and troubled and remarkably exciting. I was often sick and reliant on the guest rooms, couches and generosity of near strangers. I encountered senseless moments of acute suffering and pragmatic, hopeful responses to it. I found my place in the struggle for global health equity, discovering digital health and beginning my long and ongoing apprenticeship in human-centred design. I had the joy of co-founding a non-profit social enterprise called Medic Mobile, which merits further explanation if I am to follow Harding's (1986) call for researchers to offer a view from somewhere rather than pretending an unbiased view from nowhere.

In 2008, Medic Mobile began a partnership with St. Gabriel's Hospital in Malawi.¹ Like many low-income countries, Malawi's severe health worker shortage is exacerbated

¹ Josh Nesbit, a few others who never went on to work full time with us, and I announced the launch of our organization by blog post on February 23rd, 2009. At the time we spoke of "joining forces" because Josh had been implementing the open source software FrontlineSMS since the prior summer and writing about it on a blog titled Mobiles in Malawi. I had assembled a small team, secured a fellowship and

by the urban concentration of highly trained health professionals and the geographic dispersion of a rural population. Of the country's 27 districts, four had no doctors at all, five had fewer than one nurse per facility, and 15 had fewer than 1.5 nurses per facility as of 2004 (Evans et al., 2006). In such settings, involving a broader array of health workers can improve health outcomes while more efficiently leveraging limited health resources. Community-based lay health workers (CHWs), family members and non-medical staff can partner with clinicians, bringing new competencies and dramatically improving access to care. However, their training is minimal, they often lack the equipment or expertise to deal with complex cases and they can become just as disconnected from expert advice as the patients they serve.

To bridge this gap, Medic Mobile equipped an initial group of 75 CHWs with mobile phones and trained them to exchange text messages with a nurse at the Malawian district hospital. Many of the CHWs had never used a mobile phone, and the nurse had not used a laptop before the program began. The CHWs soon were exchanging messages for a variety of purposes, some of which were planned in advance and some of which only emerged in practice. A retrospective analysis of the first six months of the pilot found that common uses included patient referrals, reporting symptoms, requesting supplies and requesting help or advice (Mahmud et al. 2010). Most of the messages concerned patients with cancers receiving community-based palliative care, or patients with HIV or Tuberculosis.

The program at St Gabriel's is still operating independently, and now is among the older locally managed, still active mobile health (or mHealth) programs in Africa. This same approach to care coordination has since been replicated repeatedly throughout Malawi and in twenty other countries. An independent survey of CHWs at one replication site found that text messaging was 4 times less expensive and 134 times faster

become a finalist in a tech innovation for social good competition with a proposal to develop new software extending the use of electronic medical records for community health workers, using the name MobilizeMRS. We had met online thanks to Josh's blogging and decided to work together, calling our new venture FrontlineSMS:Medic. We did not change our name to Medic Mobile or receive our 501(c)(3) tax exempt legal status until 2011, but we typically refer to these prior efforts as "our work."

than walking, bicycling or taking public transit – the most common alternative means of reaching supervisors for support or reporting (Lemay et al., 2012).

1.2 An Ongoing Apprenticeship in Human-Centred Design

My co-founder Josh Nesbit’s early work at St Gabriel’s hospital in 2008 and my expansions to the program in 2009 were informed by extensive interviews, job shadowing and a cooperative process through which ways of using text messages “came about organically, developed by the CHWs and hospital staff themselves” (Mahmud, Rodriguez & Nesbit, 2010). That said, like many in the global health community, we did not use the word “design,” let alone “human-centred design” to describe these activities. We had already begun replicating this intervention in other locations, yet we had little reflective awareness or documentation of the process we were going through to get from a set of ideas and open source tools to working information systems in local health systems.

In early 2010 I began a much larger mHealth initiative which built on our earlier successes and involved several new challenges, including collecting more structured reports, integrating data across eight districts, working with more stakeholders including the Ministry of Health and multiple international NGOs, and a shorter timeline. When the program ended months later it was deemed a success: Malawi’s USAID mission made maintaining and expanding it part of their national strategy and encouraged USAID offices in other countries to undertake similar projects.

That said, in contrast with our earlier projects this whole initiative felt like a chaotic mess. During health worker trainings in the second district we discovered that we had underappreciated the workflow of local managers and that supporting their work would entail redesigning our system and re-training in the first two districts. We lacked the time, resources and in some cases the software development skills to deliver on myriad seemingly necessary adaptations, which resulted in my working inordinately long hours to keep up. We realized that our partners had not understood our descriptions of what the technology could and could not do, or they were still making sense of what they wanted, perhaps both. On multiple occasions the districts and national government and international partners did not agree about “the right way” to deal with these challenges. Reflecting on this experience, I wrote a six page internal memo about “non-technical”

and “management/implementation” challenges. I underscored the need to formalize our process for dealing with project-specific difficulties, recommending that we undertake “mini-ethnographies” at the outset of each project and pilot interventions more extensively before implementing at scale.

In hindsight, this immersive trial by fire was the beginning of my long and ongoing apprenticeship in human-centred design. After talking about the need for “mini-ethnographies” and leading discussions of “the social circumstances surrounding our technology” at conferences and online forums,² I was introduced to human-centred design by way of the design consultancy IDEO. The Bill and Melinda Gates Foundation, the world’s largest non-governmental funder of global health programs (Ravishankar et al., 2009), had recently commissioned IDEO to produce a human-centred design toolkit for organizations and social innovators working to enhance the lives of people living on less than \$2/day (IDEO, 2009). Following that engaging if poorly referenced introduction, I soon began reading more widely and attending workshops on topics such as sketching and paper prototyping. I presented at conferences about the practices of Malawian villagers who learn from local airtime vendors how to use basic mobile phones. I also documented how people charge phones in off-grid settings thanks to entrepreneurs with deep cycle batteries; both of these practices had notable implications for mHealth initiatives.³ In the Harvard Global Health Review, I wrote of mHealth Basics and Human Scalability (Holeman & Nesbit, 2010), arguing that debates about the technical scalability of digital systems (which had become popular among practitioners at that time) were far less relevant than the design challenges involved in scaling up the human activities that undergird effective mHealth interventions. By late 2010 human-centred design had become central to Medic Mobile’s approach and it remains a prominent theme in our publications and advocacy efforts.

² See for example the discussion I facilitated on the ICT4CHW mailing list in July 2011: <https://groups.google.com/forum/#!msg/ict4chw/dNNfWekvdo8/hMJD79lxbKIJ>.

³ While this work was never published in written form, the core findings are presented in a talk I gave at TEDxThessaloniki titled, Redesigning Global Health, Looking Beyond Human Error, available at <http://bit.ly/1IaMMTz>.

For the first few years human-centred design was a largely unfamiliar term in the global health community; justifying resources and dedicating ample time for it was usually difficult. Nonetheless, “our design process” became a standard introductory conversation with potential implementation partners. We persisted in incorporating fieldwork and prototyping plans into proposed budgets and timelines for new projects. As I discuss in chapter 5, human-centred design has since received much more recognition among global health practitioners. This is thanks in no small part to the Principles for Digital Development consensus statement (Waugaman, 2016), an effort in which Medic Mobile staff have been extensively involved. Despite these advances, it remains rare for global health researchers or practitioners to engage with design, design thinking, user-centred design or human-centred design at a deeper conceptual level than the recent spate of practitioner oriented toolkits and popular ‘design for business’ books (Brown, 2009; Brown & Martin, 2015; Brown & Wyatt, 2010; Martin, 2009). Many of the concerns that run through this dissertation stem from my ongoing work cultivating a more reflective and human-centred practice among Medic Mobile’s staff of more than sixty designers, engineers and implementers, most of whom live and work locally in Kenya and Nepal. Two questions in particular merit further attention because they motivated me to pursue PhD studies and are present more or less explicitly throughout this dissertation.

The first of these has to do with the nature of what we are designing and whether or in what sense successes can be scaled or reproduced elsewhere. Our early work in Malawi began with a handful of open source technologies which I was not in a traditional sense designing so much as configuring and implementing. As we grew more attentive to the fact that making effective use of them involved recommending changes in workflow and corresponding iterative reconfiguration of the tools, we began to describe the challenge at hand as a matter of service design. For many of our partners, generating workflow maps and visual accounts of key user personas was a helpful aid to cooperatively reconsidering and reshaping health services. In light of growing attention to care delivery and organizational issues in global health (Farmer, 2013; Kim, 2008; Kim, Farmer & Porter, 2013), we increasingly discussed human-centred design as a way of reimagining how care is organized and delivered. However, by late 2010 we were designing and developing our own digital tools as well, some of which are documented

at length in this dissertation (especially Chapter 3 and Appendix IV). In practice, we were simultaneously engaged in designing products, services, reorganizing the infrastructure of care delivery and advocating for changes in global health funding structures that would recognize health equity as a human right. Labrique et al.'s (2013) notion of mHealth innovations for health systems strengthening resonated with our work, but saying that we were designing “strong health systems” hardly seemed to lend clarity about the scope, materials or objectives of our manner of designing. As practitioners, we were clearly grappling with what Tonkinwise (2015) has since called post-thing-centred designing.

Being able to understand the nature of our interventions and to document them in a nuanced manner was all the more important in light of our concern with scaling and reproducing successes. From our perspective as practitioners, this was a precarious process of translating what had worked elsewhere to a new, related but ultimately unique local health system. Yet in the mainstream mHealth literature of the early 2010s, reproducibility or replicability was a standard of medical evidence, a quality supposed to be inherent in all science-based interventions. This is clear for example in guidance that before scaling up an mHealth intervention, evidence should be established in an efficacy trial (under “ideal” conditions) and replicated twice in high quality effectiveness trials under “real life” conditions (Tomlinson et al., 2013).

For an example of this experimental approach and its limitations, in 2010 researchers published a remarkable finding in the leading medical journal *The Lancet*: supportive text messages can improve the health outcomes of people being treated for HIV (Lester et al., 2010). This was different than our focus on reorganizing care to make it more efficient and timely—they had documented gains in survival of a deadly disease. Specifically, among patients starting antiretroviral therapy in Kenya, those who received supportive text messages from local nurses experienced a greater suppression of HIV-1 RNA load after 12 months of treatment. Thanks to their comparison with a randomized control group (who received antiretroviral therapy without supportive text messages), and the fact that they directly measured the concentration of virus in samples of each patient's blood, there remains little doubt that their intervention did indeed have the claimed effects on this occasion. To explain their finding, the authors argue that supportive messages improved adherence to the treatment regimen, i.e. taking pills at

the recommended time of day without missing days, and that better adherence led to better outcomes. Their conclusion was simple: supportive text messages have concrete therapeutic value in the treatment of infectious diseases. Their policy recommendation was equally simple: send supportive text messages to all people being treated for HIV in sub-Saharan Africa.

However appealing their interpretation, even a cursory analysis reveals that they glossed over details that inevitably would surface in any practical attempt to reproduce their success. For example their headline, “effects of SMS on HIV adherence” does not acknowledge that after each patient was sent a weekly “how’s it going” message, those who responded that they were doing poorly and those who did not respond received a phone call from a nurse. Their Figure 3 shows that nearly one third of patients received phone calls in any given week. One cannot help but wonder whether voice calls were integral in producing the observed effects or, as the authors argue, could replications hope to observe similar outcomes with SMS alone? And if the calls were important, did it matter that they come from a local nurse who may have a personal relationship with the patient, or could any human make the call? Does this evidence even apply to the many subsequent mHealth interventions that have automated the sending of SMS or pre-recorded voice messages, or would replicating the intervention entail attending to caring human activities?

I have not selected the Lester et al. study because it is a particularly problematic example of this tendency to underspecify and oversimplify the interventions promoted by mHealth and ICT4D practitioners. Rather, I cite it because it is a highly cited and well respected paper⁴ that exemplifies the norm in global mHealth research (most of which takes place in the fields of public health and medicine). In spite of such remarkable findings, it will be difficult for this research community to address such basic questions as what is being designed and in what sense interventions can be reproduced without a more nuanced attention to the practices inherent in digital health interventions. Medical scientists have proposed that we open up the “black box” of

⁴ As of April 5th 2017, the Lester et al. study had 760 Google Scholar citations. For a literature as nascent as global mHealth, few papers are more highly cited.

mHealth interventions by developing lists of intervention elements and testing the influence of each through a controlled field experiment (Tomlinson et al., 2013). As an alternative, one of the central projects of this dissertation is to advance a more nuanced notion of sociomaterial practices, in which bundles of human activity and concrete materials are considered together as integral aspects of the practice—the intervention—as a whole.

The second major question that motivated me to pursue post-graduate studies has to do with the relationship between human-centred design and other activities of implementation and health systems strengthening already discussed. Any extended exploration of how design is relevant to global health practitioners, particularly if we embrace a post-thing-centred view of designing, must grapple with the fact that practitioners already pursue much this kind of digital innovation without necessarily identifying as designers or describing their activities as design-oriented. Many speak of developing new technologies and innovation that is informed by cooperation with local health workers and community members. These practitioners obviously conduct interviews, hold meetings or do fieldwork to discover local priorities and make sense of their observations in ways that reframe the course of their work. They pursue pilots and iterative form-giving activities in their own way. I understand this perspective all too well, for I had also been involved in a cooperative process through which innovative ways of using text messages “came about organically” without having reflective awareness of my work as designing.

To explain the distinctive value of human-centred design for global health practitioners, I needed to determine at a conceptual and practical level how human-centred-design differs from related terms that many practitioners and the popular design literature use interchangeably, such as design thinking and user-centred design. This is the central question I address in practitioner-oriented Chapter five. More broadly, I needed related concepts that speak to the pragmatic manner in which people in a variety of fields already make sense of complexity, ambiguity, uniqueness, conflicting values and rapid change. To this end we now turn to the literature on sensemaking. Having located my ongoing apprenticeship in human-centred design as the ‘jumping off point’ for this research, my next aim is to relate the literatures on sensemaking and

human-centred design so that subsequent chapters, which deal independently with sensemaking or design, can be read as a connected account.

1.3 Sensemaking and Human-Centred Design

Some years ago, HCI researcher Panu Korhonen of Nokia outlined to me how HCI is changing, as follows: In the early days the Nokia HCI people were told “Please evaluate our user interface, and make it easy to use.” That gave way to “Please help us design this user interface so that it is easy to use.” That, in turn, led to a request: “Please help us find what the users really need so that we know how to design this user interface.” And now, the engineers are pleading with us: “Look at this area of life, and find us something interesting!” This, in a nutshell, tells a story of how HCI has moved from evaluation of interfaces through design of systems and into general sense-making of our world. (Bannon, 2011, p.50)

In ordinary practice, problems of real human concern typically do not present themselves to practitioners as givens. Rather, people face a stream of experiences and perceptions which all too often are confusing and disorienting. To construct a concrete actionable problem out of the details of a problematic situation, the practitioner must do a certain kind of work. She must orient herself to salient features of the situation at hand. The way we make sense of complex, ambiguous, unique, contentious and rapidly changing situations typically precedes our ability to apply systematic problem solving techniques or successfully implement off-the-shelf technologies. This is not to say, however, that our sensemaking is inevitably haphazard, wholly improvised or driven by a mysterious and untraceable intuition. Depending on the practitioner’s background, she might well practice and cultivate skills relevant to the ongoing task of sensemaking. As Bannon suggests in the quote above, a growing number of design practitioners and researchers view human-centred design as a proactive and sophisticated way of approaching this broader task of sensemaking.

1.3.1 Sensemaking in the Design Literature

In the design literature, the notion of sensemaking has been important at least since Schön's (1983) classic work on design as a reflective conversation with materials.⁵ For example he observes that:

In real-world practice, problems do not present themselves to the practitioner as givens. They must be constructed from the materials of problematic situations which are puzzling, troubling, and uncertain. In order to convert a problematic situation to a problem, a practitioner must do a certain kind of work. He must make sense of an uncertain situation that initially makes no sense (1983 p. 40).

For Schön, accounting for the intuition or even artistry with which people make sense of nebulous or poorly defined challenges is particularly important if they are to address matters of great human concern:

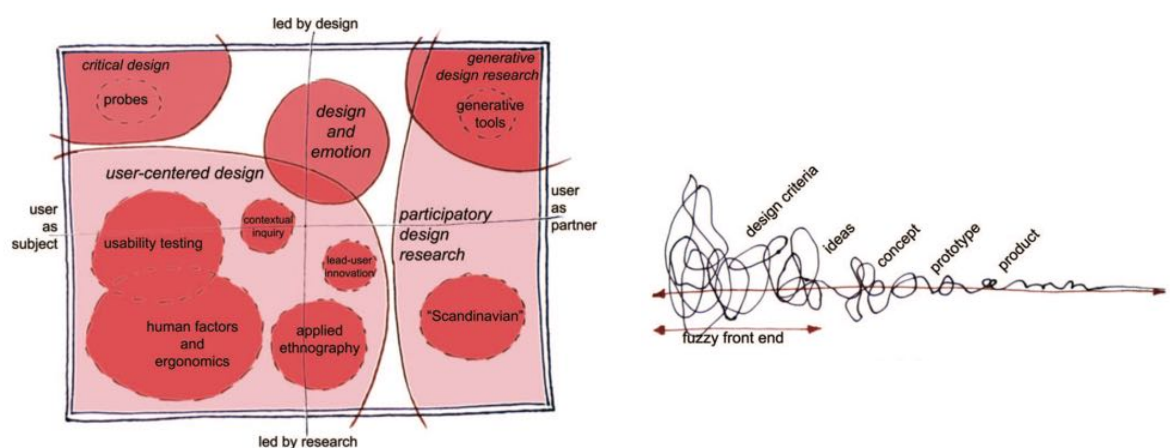
In the varied topography of professional practice, there is a high, hard ground where practitioners can make effective use of research-based theory and technique, and there is a swampy lowland where situations are confusing "messes" incapable of technical solution. The difficulty is that the problems of the high ground, however great their technical interest, are often relatively unimportant to clients or to the larger society, while in the swamp are the problems of greatest human concern. Shall the practitioner stay on the high, hard ground where he can practice rigorously, as he understands rigor, but where he is constrained to deal with problems of relatively little social importance? Or shall he descend to the swamp where he can engage the most important and challenging problems if he is willing to forsake technical rigor? (1983, p. 42)

This pragmatic characterization of the dilemma of rigor or relevance is one of Schön's lasting contributions. As a critique of purely technical or scientific notions of design as presented for example in the work of Simon (1996), many design theorists will see this point as related to prior and subsequent discussion of poorly structured or wicked problems in design (Buchanan 1992, Rittel & Webber 1973). The dilemma of rigor or relevance can also be read as a call for designers to look beyond the familiar

⁵ This is not to say that Schön was the first to describe design in terms that suggest a kind of sensemaking. For example, a decade earlier Victor Papanek's classic *Design for the Real World* (1971, p.4) defined design as "the conscious and intuitive effort to impose meaningful order." Rooting this analysis in Schön's work is helpful here because he is widely recognized as a canonical design scholar and because this foreshadows engagement with his work throughout the dissertation.

“high, hard ground” of discrete objects and interfaces, attending to the broader human contexts of design challenges. To a significant degree this perspective has been internalized in contemporary design research and practice; it is not always discussed in reference to Schön and it does not always use the terms sensemaking or ‘making sense of.’ For example, Sanders and Stappers (2008) offer a map of the current landscape of human-centred design circa 2008 and a visual representation of a process widely embraced across this landscape. In reference to the iterative turns and strange loops that characterize designing, they note that “The front end is often referred to as ‘fuzzy’ because of the ambiguity and chaotic nature that characterise it. In the fuzzy front end, it is often not known whether the deliverable of the design process will be a product, a service, an interface, a building, etc.”

Figure 1.2: Map of the design landscape, Sanders and Stappers (2008)



In this manner making sense of ‘fuzzy’ and ‘chaotic’ experiences may be identified as central to the process of designing even among researchers who do not call the phenomenon ‘sensemaking.’ Nonetheless the term sensemaking or sense-making does continue to surface in the design literature as a way of describing this fuzzy part of designing, particularly in relation to the transition, described above by Bannon, beyond a narrow focus on interfaces or discrete things. For example Dorst’s (2015) recent work on frame innovation, Manzini’s (2015) treatment of participatory approaches and designing for sustainability, and Tonkinwise’s (2015) discussion of the political values inherent in “post-thing-centred designing” all depict sensemaking as integral to form

giving in the contemporary practice of design. Comprehensively reviewing these treatments of sensemaking in the design literature is beyond the scope of this introduction. For our purposes it will suffice to say that a number of important works argue that expanding the scope or aims of design involves engaging broader organizational and societal contexts of implementation in ways that engender sensemaking. With this point in mind, we might now consider how sensemaking has been treated in the organization studies literature.

1.3.2 Sensemaking and the Process of Organizing

In organization studies, most associate the notion of sensemaking with seminal work by Weick and Kiesler in *The Social Psychology of Organizing* (1979) and Weick's later *Sensemaking in Organizations* (1995). Recent reviews observe that the notion of sensemaking has had a major impact on organization studies (Maitlis & Christianson, 2014; Sandberg & Tsoukas, 2015). It has advanced social-constructionist, interpretive and phenomenological perspectives (Holt & Sandberg, 2011) and catalysed processual studies of organizing (Hernes & Maitlis, 2010; Langley et al., 2013; Tsoukas & Chia, 2002; Weick, 2010).

Maitlis and Christianson (2014, p.58) describe sensemaking as “the process through which individuals work to understand novel, unexpected, or confusing events.” One important body of research concerns how sensemaking enables related organizational processes such as change initiatives, responses to crises, learning, creativity or innovation. Another body of research more directly concerns how sensemaking is accomplished in organizations. In this view, “sensemaking goes beyond interpretation and involves the active authoring of events and frameworks for understanding;” it is more concerned with invention than with discovery insofar as “people play a role in constructing the very situations they attempt to comprehend” (Maitlis & Christianson, 2014, p.58).

This distinction between interpretation and sensemaking will be familiar for design researchers who have investigated, often in reference to Schön's work, the co-evolution of problems and solutions in design practice (Dorst & Cross, 2001). This is not to say however that students of organizing and students of design are engaged in a coherent joint exploration of sensemaking. The situation may better be described as one of

relatively bounded and distinct scholarly communities that have, with respect to sensemaking, benefited from cross-pollination in recent decades.

We see this cross-pollination for example when articles in design journals use Weick's work on sensemaking to account for "design as a way of organizing complexity or finding clarity in chaos" (Kolko 2010b; Kolko 2010a, p.15). We see relative disjuncture when another article in a design journal cites Kolko's work and discusses designers "using making as a way to make sense of the future" (Sanders & Stappers, 2014) without citing Weick's work or the organizational literature on sensemaking.⁶ We see crossover in Academy of Management Journal publishing an ethnographic study of a design firm, describing design work as a kind of prospective, materially mediated collective sensemaking (Stigliani & Ravasi, 2012). Yet there is relative disjuncture in that this study contributed to the organizational sensemaking literature without substantively engaging research on designing and sensemaking (or sense-making or 'making sense of') that had been published in design journals. In another case of cross-pollination, a study in Academy of Management Journal (Whiteman & Cooper, 2011) argued that "Schön's (1983) research on how 'senior practitioners' utilize tacit knowledge suggests that the ability for 'reflection in action' (1983, p. 49) is an expert form of sensemaking" (p. 891). In the Journal of Management Studies, Yanow and Tsoukas (2009) develop a phenomenological re-reading of Schön's work, emphasizing his attention to "material back-talk" in his framing of design as a conversation with materials. The resonance of Schön's work (and later re-readings of it) with the organizational sensemaking literature is clear in the manner that this view of material back-talk was later mobilized in Sandberg and Tsoukas' (2015) review of organizational sensemaking, as follows:

It is not so much that purposeful actors, equipped with articulated plans, deliberately re-shape their actions by obtaining explicit feedback as they go on with their tasks, as that actors habitually act on the basis of who they historically have been (Sandberg & Targama, 2007, Ch. 4), observe the "backtalk" of their actions (Schön, 1987; Yanow & Tsoukas, 2009), and obtain a clearer sense of what is going on and who they are, spontaneously adjusting their actions accordingly (Sandberg & Tsoukas, 2015 p. 19).

⁶ Note that Sanders and Stappers are the same two well respected design scholars responsible for the images featured earlier of the landscape of human-centred design and the "fuzzy" design process.

As I wrote previously, comprehensively reviewing how sensemaking is being discussed in either or both of these literatures is beyond the scope of this introduction. My more modest aim is to establish that design and organization researchers share an interest in how people make sense of and respond to situations of complexity, ambiguity, uniqueness, conflicting values and rapid change. While there has been some substantive cross-pollination across these literatures, the relative disjuncture no doubt reflects the fact that constructing contributions to knowledge is a joint undertaking, the course of which is shaped by the exigencies of peer review and the norms and infrastructure of publication that characterize relatively distinct communities of scholarly practice. To explore how the present work is shaped by the disciplinary communities to which it contributes, we will now consider the logic and structure of the paper-based dissertation.

1.4 The Structure and Aims of the Portfolio Format Dissertation

Paper-based or portfolio format dissertations are a relatively recent development at the Cambridge Judge Business School and they are quickly becoming the norm. For the benefit of examiners I have included in Appendix I the section of the Judge's 2016 PhD student handbook that describes this approach. Building on that framework, I would like to offer my own argument about how the structure and aims of this format are similar to and different from the more traditional dissertation monograph. First, University guidelines⁷ stipulate that:

Before recommending the award of the PhD Degree the examiners must satisfy themselves that the dissertation:

- 1. is clearly written*
- 2. takes due account of previously published work on the subject*
- 3. represents a significant contribution to learning, for example through the discovery of new knowledge, the connection of previously unrelated facts, the development of new theory, or the revision of older views; and*
- 4. approved in the light of what it is reasonable to expect a student to complete within three years full-time (five years part-time) research.*

The limitations implied by this advice are intended to apply to the scale and scope of the work presented in the dissertation but not to its quality.

⁷ Guidelines retrieved April 4 2017 at: <http://www.cambridgestudents.cam.ac.uk/your-course/examinations/graduate-exam-information/submitting-and-examination/phd-msc-mlitt>

An additional aspect of these guidelines merits further attention:

A dissertation must be a connected account of research written by the candidate. The dissertation must not simply consist of a collection of unconnected or unrelated papers published or otherwise. However, it may include published or publishable work provided it is part of a connected argument and is uniform in presentation and format with the remainder of the dissertation. It may also include appendices which are relevant to the material contained in the dissertation but do not form part of the connected argument.

Portfolio format dissertations, which the Judge PhD handbook also calls three-paper dissertations, must also meet these criteria. As the PhD handbook notes, this format additionally “supports the development of a ‘job market paper’, which is the best individual paper and will be the basis for job applications and presentations at interviews.” However, we need not think of the portfolio format as a mere concession to practicality. I would like to elaborate on how it might be taken to involve a nuanced reinterpretation of the classic university-wide criteria stated above.

In many fields, including organization studies, information systems, CSCW and HCI, academic monographs are no longer a standard feature of the academic’s tenure portfolio (if ever they were). When academic books in these fields feature original research, they typically are compendia of relatively independent works in which each chapter offers a standalone contribution to learning. This is the basic expectation for a portfolio format dissertation—that the core chapters are publishable articles which each make a standalone contribution to learning. When the organization or information systems researcher produces a monograph dissertation, their next major task typically involves extracting out and re-writing several standalone papers. This is an extended endeavour which can last a year or more before submission to journals. Following submission, engaging constructively in the process of peer-review takes additional months or years and requires academic skills beyond what is required to produce a dissertation monograph. Part of the practical appeal of the paper-based format is that it affords an opportunity for junior researchers to practice skills for navigating peer-review with the close support of an engaged supervisory committee.

Rather than simply accepting this trend as a social fact, we might better understand the nature and value of the paper-based dissertation by exploring how such disciplinary trends are produced. Weinberg (2002) argues that wherever a research method or standard of contribution to learning has gained favour among a particular group of

researchers, it remains contested (or ignored, trivialized etc.) by other groups of researchers. Rather than constructing every contribution to learning from first principles, it is a clear matter of historical fact that most scholarly debate proceeds within relatively bounded “dispute domains” that share some common premises on matters of theoretical perspective, method of inquiry, topic of interest, process of peer-review and format of contribution. For the most part, contribution to scholarly disciplines and sub-fields revolves around a recognizable locus of interrelated journals and scholarly presses. On this basis Weinberg argues that all research method ultimately has some degree of rhetorical operation:

It is only by explicitly granting that our ideas are always contestable, and endeavouring to discover, anticipate, and respond effectively to the precise ways in which they are contestable, that we might give our ideas whatever scientific legitimacy they may come to possess (2002, p. 3).

Such a view is particularly important when we consider the value of ethnographies and other studies based on small sample sizes. According to King and Sznajder’s (2006, p. 764) neo-Lakatosian view, even a single case may have more impact than a representative sample if that case speaks to a specific argument in a compelling manner. This is because “science advances not in any single confrontation of ‘theory’ with ‘facts,’ but with defensive attempts by scientists to save their original theories.” In this view, the appropriate form and relative significance of contributions to learning are not known definitively in advance, in reference to published manuscripts or by adherence to gold standards of theory or method. As the 2003 Nobel Prize laureate Paul Lauterbur put it, “you could write the entire history of science in the last 50 years in terms of papers rejected by Science or Nature.”⁸ What constitutes a substantial contribution to learning is also worked out on an ongoing, manuscript-by-manuscript basis by attending academic conferences to get feedback on new data and ideas, seeking friendly review on drafts, and ultimately through the crucible of peer review. Broadly, this view of how scientific knowledge is produced holds that engaging in peer review is integral to the

⁸ Quoted in the New York Times article, American and Briton Win Nobel for Using Chemists' Test for M.R.I.'s, available at <http://www.nytimes.com/2003/10/07/us/american-and-briton-win-nobel-for-using-chemists-test-for-mri-s.html>.

creative and cooperative process of constructing contributions to learning, rather than a mere formality to be addressed after real discoveries have been made.

Seen in this light, the distinctive value of the portfolio format dissertation is that it affords more substantive engagement with peer-review in fields where the vast majority of contributions to learning take the form of journal articles or standalone book chapters. This enables examiners to consider a dissertation's contributions to learning much as they would other contributions to learning in their field. Whether a dissertation takes due account of previously published work can be addressed on a contribution-by-contribution, chapter-by-chapter basis in relation to the specific publication(s) a particular chapter targets. Given the university criterion that the dissertation be approved "in light of what is reasonable to expect a student to complete within three years full-time," some disciplines may expect actual publication and other disciplines may look for other evidence of such engagement, such as having presented papers at conferences, submission to journals or offers to revise and resubmit papers. It may also involve discussion in the written dissertation or its oral defence of how the literature reviews and statements of contribution of particular chapters were tailored to particular journals, or tailored based on direct feedback from editors and anonymous reviewers.

As any seasoned researcher will be aware, editors and anonymous reviewers exercise considerable power in the review process. Taking their suggestions seriously can, often with good reason, make it more difficult to emphasize the connections across a series of papers (of which the reviewers will have seen only one). Thus for obvious reasons the typical associate professor's tenure portfolio is not typically expected to advance a single monolithic argument through every single publication. Quite often tenure committees expect the portfolio to exhibit a connected arc in other ways, for example showing evidence of a clearly recognizable disciplinary home and contributions to learning on themes that are interrelated enough for the researcher to claim legitimate, noteworthy expertise on a coherent area of inquiry. I would argue that on similar grounds, relative inattention to a singular monolithic argument spanning the entire dissertation portfolio need not be seen as a limitation in the quality of contributions to learning. Insofar as it reflects serious engagement with the exigencies of peer review, it might instead be read as a sophisticated bounding in the scope of each contribution. This may be particularly true if the work exhibits a connected argument in other ways. While the introduction

and conclusion to the portfolio may draw attention to themes that connect the standalone papers, these too will be bounded in scope in light of what a student can reasonably be expected to produce in three years full-time.

In my own dissertation, the standard of interconnected argument is perhaps clearest when we consider that I have included the three standard scholarly papers and a practitioner-oriented paper as dissertation chapters, while three published articles are included only as appendices. All three of the articles in the appendices concern ICTs, global health and human-centred design, thus they are not merely “a collection of unconnected or unrelated papers.” And yet, they do not meet my standard for presenting a connected arc because of the manner in which each article was tailored to the disciplinary community in which it was published—two were published in medical journals and one in an engineering conference. Given that the University of Cambridge grants only a general Doctor of Philosophy degree rather than PhDs in particular disciplines (e.g. a Phd *in* innovation studies), it is fitting that I would construct this disciplinary home on my own terms, through participation in the information systems, organization studies and ICT4D fields, with influences from science and technology studies, computer supported cooperative work and global health. In the following section I will elaborate on the details of each chapter and the appendices and offer some further explanation of how I have engaged the process of peer review.

1.5 Plan for the Thesis and Chapter Outlines

Breadth of study and multidisciplinary perspective were hallmarks of my undergraduate education in the liberal arts and biochemistry. As a graduate student I have taken great care to nourish these pillars of my scholarly identity, pursuing a range of research opportunities and thriving in the diverse intellectual community at the University of Cambridge and at King’s College in particular. In the course of my studies I have written seven first-author articles with fourteen co-authors. To date, evolving versions of these manuscripts have been submitted to journals⁹ a total of twelve times,

⁹ I include here engineering conferences such as ACM DEV, in which full papers go through a rigorous process of peer review and revision before acceptance and in which the published proceedings serve as archive of record.

receiving five offers to revise and resubmit and seven rejections. The three articles that have been published have received fourteen citations. One of these was a highly technical paper for an engineering conference focused on ICT for Development; the other two were published in medical journals and rank in the 97-98th percentile of the more than 7.5 million articles tracked by altmetrics, an algorithmic measure of attention to peer-reviewed research in news media, blogs and social media.¹⁰ Additionally, Chapter 3 was accepted for publication in the Journal of the Association for Information Systems shortly after the initial submission of this thesis. I believe that the breadth of this dissertation is one of its clear strengths.

While interesting and often influential in the long term, multidisciplinary work also is extremely challenging. Breadth can be a real weakness if it muddles why particular cases and conceptual themes have been selected for inquiry or how particular contributions speak to a broader conversation. For this reason it is important that I lay out a clear plan for the thesis.

In light of my concerns as a practitioner, I began a period of extended reflection and hoped to start a conversation with other researchers about human-centred design for global health equity, which implies a concern with health systems strengthening in settings of poverty. Framing this research problematic in more general organizational terms, this thesis explores how people address challenges of real human concern, even when the work is characterized by complexity, ambiguity, uniqueness, conflicting values and rapid change. Two research questions emerge from this broader inquiry:

1. What exactly can design work be said to produce, when we recognize that designers matter but are far from all powerful, that they build technologies but also remain deeply concerned with health systems and organizations?
2. What can we learn from more general studies of sensemaking, that may help us understand the nature or relevance of a human-centred design practice that

¹⁰ For further explanation, the altmetrics pages for these articles are available at: <https://www.altmetric.com/details/11908736> and <https://isaacholeman.altmetric.com/details/2798836>.

goes beyond technical fixes to generate responses to more complex human challenges?

The division of labour for the portfolio is as follows. I address the first of these questions in Chapter 3, developing the notion of designing for the emergence of sociomaterial practices as a holistic way of framing what design work produces and the limited yet consequential role that designers play in this process. With respect to case selection, drawing on empirical material from a global health initiative involving new technology design and an explicit emphasis on coordination and health systems strengthening seemed highly relevant to this question.

I address the second core question in Chapter 4, drawing on an unlikely voyage of the Amazon river to develop the visceral and tactile notion of sensemaking in the flesh. As with the case selected for Chapter 3, this record-setting voyage of the Amazon clearly involved surmounting myriad complexities and practical challenges. Yet it did not involve the design or production of concrete artefacts or the strengthening of global health programmes. As a matter of case selection, this point of empirical contrast seemed as relevant and helpful as the point of conceptual similarity, for my purpose with the second question above was to explore sensemaking in broader organizational perspective.

As my work on these two core empirical chapters progressed, some clear differences began to emerge with respect to how we were theorizing sociomaterial practices. These differences made sense in terms of my empirical and analytical process, for I was using different data, collaborating with different co-authors, targeting different publication outlets (Information Systems and Organizational Theory), and in the case of Chapter 3 already receiving highly opinionated feedback from anonymous reviewers. Despite the internal coherence of each of my chapter-level empirical contributions, I began to worry that the broader arc of my work would be viewed by critics as promoting “conceptual *mélanges* that are philosophically incoherent and incongruent” (Niemimaa, 2016 p. 46). Thus in response to the increasingly philosophical tone of the sociomaterial practice discourse, a third research question emerged:

3. What does it mean to discuss sociomaterial practice as an umbrella term; can there be a logically coherent, conceptually sophisticated basis for pluralism within this discourse?

In my application to the PhD program I had proposed to do an additional ethnographic study with community health workers in Liberia, but this agenda was forestalled by the Ebola epidemic. In hindsight, this great human tragedy was perhaps not as great a setback for my scholarship as it initially had seemed. Addressing this third question involved reviewing so great a conceptual terrain that it was less suited to a focused ethnographic study than to a theoretical essay. For this reason I chose to develop the notion of Room for Silence through a theoretical essay that offers a brief empirical sketch of the Ebola epidemic for illustrative purposes.

With Chapter 5, I return to the theme of human-centred design for global health equity, with a focus on speaking to a practitioner audience. For this reason this chapter also reflects more explicitly on my experiences as a practitioner at Medic Mobile. To further foreshadow how the reader might trace connections among these chapters, I will now outline each of them sequentially, as they appear in the dissertation.

1.5.1 Room for Silence: Pluralism and the Pragmatic Study of Sociomaterial Practices

This essay concerns efforts among practice theorists to recast “the social” and “the material” in technology studies, challenging the separation of technology, work and organization. In this broad view, materiality refers not only to the physical properties of machines but also to software and algorithms, electrical grids and other infrastructure, buildings, roads, human bodies etc. Drawing on feminist perspectives in science and technology studies, the term sociomaterial practice speaks to a view of recurring activity in which people and materials are generative and analytically inseparable, being always already entangled.

Despite remarkable enthusiasm for the notion of sociomaterial practices, the discourse occasionally has devolved into philosophical turf wars, engendering pleas for pluralism. On the other hand, some see the discourse as irrelevant to pragmatic concerns such as fieldwork methods and technology design implications. I argue that pluralism and practicality are related, and that they might both be addressed through an

orientation to theory that I will call room for silence. For the ethnomethodologically inclined, room for silence is a matter of methodological rigor and theoretical sophistication. For the pragmatically inclined, room for silence has to do with the dilemma of rigor or practical relevance. Like pluralism in the broader turn to practice in social theory, I argue that pluralism in the study of sociomaterial practices must be sweeping enough to grant researchers room for silence with respect to some theoretical and Ontological commitments. Granting room for silence is particularly important if sociomaterial perspectives are to find purchase in the pragmatic work of designing human-centred systems in complex and challenging situations.

While this essay has not yet been submitted to a journal, it was written with the aim of publication in an outlet such as *Information and Organization*, which has published a number of critical essays concerning the study of sociomaterial practices (Kautz & Jensen, 2013; Leonardi, 2013; Mutch, 2013; Scott & Orlikowski 2013), or *The Journal of Computer Supported Cooperative Work*, in which practical design issues, pluralism, and ethnomethodologically informed work in the tradition of Suchman (2006) have been important for decades (Schmidt & Bannon, 2013). In some respects this paper might be seen as standing in for the theory chapter that one would expect to find in a traditional dissertation monograph. It extensively reviews the theories of practice and notion of sociomaterial practices that are analytically central, even while being reviewed more lightly, in the subsequent empirical chapters. It also introduces the notion of biosocial organizing, which was part of Chapter Three until reviewers pointed us in another direction and which foreshadows the attention to the body that remains more central in Chapter Four. For this reason I have placed it first in the dissertation, even though it was written last and has benefited greatly from my reflections on fieldwork, analysis, writing and peer-review experiences with the dissertation's two empirical chapters.

1.5.2 Designing for the Emergence of Sociomaterial Practices

Insights from an ICT4D Initiative in Kenya's Immunization Program

ICT4D initiatives hold potential to transform health service delivery in settings of poverty, yet in practice they face many of the same implementation complexities and coordination challenges as the global health and development programs that they aim to

streamline or strengthen. Researchers and practitioners alike are now quick to observe that ‘context matters,’ but this does not amount to a coherent alternative vision of more appropriate ICT4D design and implementation. In this article we draw on the metaphor of imbrication to elucidate the iterative process by which ICTs become entangled with particular contexts of use. Our longitudinal ethnographic study examines the implementation and iterative redesign of an Internet of Things technology that collects real time data and alerts health workers of disruptions in the cold storage of vaccines in Kenya.

Extending recent work on imbrication, we show that technologies imbricate not only with the social context but also with local material infrastructure, and that designers play a limited yet clearly consequential role in this process. To explain these findings, we highlight instances of material “back talk” and concomitant practice breakdown, in which initial attempts to shape a situation yield puzzling or unappreciated consequences, leading designers to accommodate material realities and ultimately pursue unanticipated courses of action. Drawing on these conceptual tools, we reveal six overlapping activities through which designers may guide the emergence of sociomaterial practices. We say that they design for the emergence of sociomaterial practices to underscore that designers cannot predict or control all contextual complexities, though they can adapt to them when they arise. Based on our insights about this process we develop three contributions. First, we offer fresh perspective on the longstanding concern with local context in ICT4D research. Second, we suggest that our notion of designing for the emergence of sociomaterial practices is relevant for and adds to contextually aware design research frameworks such as Action Design Research. Finally, we propose that ICT4D practitioners should attend to practice break downs and material back talk as they grapple with the complexities of the implementation bottleneck in global health and development.

Fieldwork for this study began during my year of MPhil studies in Cambridge’s sociology department and continued periodically during my first and second year of PhD studies. Co-authored with my supervisor Michael Barrett, early versions of the manuscript emphasized the discourses of implementation research (Fixsen et al. 2005) and global health care delivery (Farmer, 2013; Kim, 2008; Kim, Farmer & Porter, 2013) that have commanded increasing attention in global health research and practice

and that greatly influenced my decision to pursue PhD studies at a business school. This framing was utterly unappreciated by reviewers at a respected organization studies journal, which was an important learning experience concerning the challenges of interdisciplinary publishing. In late 2015, after extensive revision, the paper was resubmitted to a special issue on ICT for Development in the *Journal of the Association for Information Systems* and we have subsequently revised and resubmitted it twice, with major revisions on each occasion. The theme of imbrication did not arise until the latest revision at the strong suggestion of reviewers. While sociomaterial practice is a core theme of this paper, it does not attend to human bodies in the manner suggested in Chapter Two's discussion of biosocial organizing. The body resurfaces centrally, however, in Chapter Four.

1.5.3 Sensemaking In The Flesh

This study examines how people make sense of novel, unanticipated or confusing experiences, responding in practical ways to uncertainty and change. Despite significant advances, empirical studies of sensemaking have tended to depict the phenomenon as a cognitive process centred on interpretation. While Weick's early work positioned sensemaking more holistically as arising from immersion in the stream of experience, reliance on archival data and retrospective interviews may have contributed to today's relative neglect of action and the bodily senses. In this paper, we rely on a unique ethnography of a world-first attempt to scull the navigable length of the Amazon river. Drawing on extensive video data, we were able to document the concrete work of sensemaking as it unfolded in response to serious risks, routine uncertainties and puzzling surprises.

Our three empirical findings relate to 1) the bodily task of sensing our way into action; 2) how action is situated in the material world; and 3) the provisional character of sense, the making of which is a skilled and ongoing accomplishment. These interrelated findings sketch a tactile notion of sensemaking that we call sensemaking in the flesh. We use this phrase to suggest physical presence as well as a connotation of contact and materiality that transcends human bodies—to flesh out is to add substance. In the flesh also suggests studying sense and sensemaking activities at their point of production. Drawing attention to pragmatist and phenomenological influences in

Weick's (1995) seminal work on sensemaking, we argue that practice theoretical perspectives, ethnographic methods and the use of video data might ameliorate several recognized shortcomings in recent sensemaking research.

While this study has not been submitted for publication, it has been tailored for submission to a journal such as *Administrative Science Quarterly* or *Academy of Management Journal*. This chapter illustrates the strengths of the portfolio format dissertation in several respects. Collaborating with my supervisors Mark de Rond and Jennifer Howard-Grenville, this paper was an opportunity to step beyond my comfort zones of global health, digital technology and conducting my own fieldwork—areas in which I had substantial expertise before beginning post-graduate studies. Analysing video data generated during de Rond's fieldwork enabled me to serve as the 'outside' partner in an insider-outsider analysis. This was a remarkable opportunity to reflect on how I conduct my own fieldwork, in particular how I document and rely on memories of felt experiences in the process of writing. These reflections are central to how I now discuss a view from practice as distinct from the spectatorial orientation of many studies of practice. Studying a case that did not involve technology design forced me to reflect on the experience of designing in new ways, leading me to theorize designing and sensemaking in more general conceptual terms, as well as to explore the links in the literatures that I outlined earlier in this chapter. Finally, while I have long felt at home in the global health community, I have been made acutely aware that virtually every global health program I would imaginably study will be perceived as an "extreme case" or "challenging setting" by mainstream organization studies and information systems researchers in Europe and North America. Writing about a very different kind of challenging setting—this voyage of the Amazon river—exposed me to practical strategies for building theory from atypical cases. The contributions to learning that we offer in this paper, and moreover this chapter's profound influence on my educational experience, would not have been possible without the relative flexibility to work on multiple connected but standalone studies that the portfolio format affords.

1.5.4 Human-Centred Design for Global Health Equity

Chapter five is a brief 'bonus' chapter beyond the three standard scholarly chapters. This high-level, selective review of the relevant literature was co-authored with a

practitioner, Medic Mobile's Chief Design Officer. Practically speaking, it might be read as part of my attempt to launch an academic career in a post-REF world. Recent developments in the Research Excellence Framework place a premium on "changes and benefits to the economy, society, culture, public policy and services, health, the environment and quality of life that have arisen from research" (Grant, 2015, p. 6). While I have addressed 'implications for practice' within my scholarly chapters, this traditional format is no longer regarded by the REF as sufficient evidence of impact beyond academia. Much of the work that does meet this high bar is, like my Chapter five, highly multidisciplinary. For the impact case studies submitted for the 2014 REF, almost two thirds were associated with two major disciplines and 87% were associated with at least two sub-fields (Grant, 2015, p. 24). Given the demands of having a public impact and addressing the divergent expectations of multiple scholarly communities, only 42% of REF 2014 impact case studies that had a DOI were submitted as research outputs to REF 2014 or other research assessment exercises (Digital Science, 2016, p. 14). That is to say, pursuing public impact to the standard set by the research excellence framework entails producing scholarly work in a range of formats.

In light of this trend, it would not be consistent with the spirit of the REF or my scholarly trajectory to assess this chapter on strictly the same terms as the preceding scholarly chapters. Rather than reading this as an 'implications for practice' follow-on to the dissertation's scholarly chapters, I would encourage my examiners to read it as a standalone experiment in public scholarship. It is connected with the dissertation's core themes yet it speaks to a wider public conversation, attempting to make some of the design and information systems research tradition available to global health practitioners and policy makers.

We argue that human-centred design is a replicable approach to innovation that puts people at the centre of activity, prioritizing their needs, desires and behaviours in the design of complex systems. As digital technologies play a growing role in health care, human-centred design is gaining traction among global health practitioners and funders. This is not to say that human-centred design is a recent development, however. It is better understood as an umbrella term with a long and complex history. Amid recent concern that human-centred design is becoming a global health and development

buzzword, it is timely to reconsider what human-centred design entails and how it differs from related practices such as design thinking.

Our paper clarifies this conceptual terrain by first exploring the relevance of a conventional design thinking approach to global health practitioners. We offer insights about designerly approaches to formative research and explain how iterative methods reframe the relationship between design and implementation. We then explain how human-centred design may go beyond this tradition. While there is no definitive agreement about what the ‘human’ part of the term is supposed to mean, it often implies stakeholder participation, orienting to human skills and attention to values, human rights or humanitarian concerns. In this sense human-centred design is not a method for building technologies or for solving purely technical problems so much as it is a way of making sense of the complex challenge of health systems strengthening in a digital age.

Early versions of the manuscript discussed practical implications of sociomaterial entanglement, but references to this term have been iteratively filtered out through the process of peer-review. Explicit discussion of the sensemaking literature has also been reduced from earlier drafts. Nonetheless the careful reader will perceive how these concepts inform the analysis. Conceding these points for the sake of engaging to a lay audience was initially frustrating, but I have also come to see such accommodations as integral to the pragmatic challenge of writing articles that practitioners will actually read. In this regard I follow the example of Mary Parker Follett, the influential pragmatist and administrative theorist who influenced Weick’s notion of sensemaking as we discuss in Chapter Four. In some respects her work from the 1930s seems prescient; as we discuss in Chapter 4 she influenced Weick’s notion of sensemaking and foreshadowed the analysis of material back talk that Schön would develop half a century later. Yet later in her career she engaged the practitioners of her day in language that they would find familiar, at the risk of being misinterpreted and in many cases underappreciated by her own field of study (Snider, 1998).

The argument that human-centred design goes beyond—is recognizably distinct from—design thinking may seem a rather modest conceptual contribution in scholarly terms. Yet in popular rhetoric this is a matter of widespread and frequent misconception, as we make plain in the article itself. Moreover, poorly informed popular rhetoric has begun to enter the academic literatures of disciplines that have less robust

traditions of design research, including the medical literature. Digital innovation researchers are in a distinctive position to address such challenges, not necessarily by becoming medical researchers or practitioners but by engaging their discourse with reference to our own scholarly tradition. This manner of public scholarship is what differentiates this article from some of my other publications which address similar global health challenges, but which are included only as appendices because they are not as connected to this dissertation's disciplinary home.

1.5.5 Appendices II, III and IV

The second appendix is the abstract of a paper I published in 2014 titled, *Mobile Health for Cancer in Low to Middle Income Countries: Priorities for Research and Development*. In it my co-authors and I argue that cancer researchers and practitioners have an opportunity to leverage mHealth technologies that have successfully targeted other health conditions, rather than reinventing these tools. We also call for attention to human-centred design as an approach to adapting existing technologies to suit distinctive aspects of cancer care and to align delivery with local contexts of implementation.

Appendix III is the abstract of an article published in 2016 titled *Digital Technology for Health Sector Governance in Low and Middle Income Countries: A Scoping Review*. This article reviews how digital tools are being used to facilitate good governance and combat corruption, absenteeism and fraud, which are widely recognized problems in global health. While many digital good governance interventions are driven by an assumption that transparency alone will effect change, we argue that responsive feedback mechanisms are also likely to be necessary. Moreover, we observe that good governance interventions in health care are deeply complex. Their outcomes hinge on distinctive political factors in addition to the myriad organizational and sociotechnical dynamics that shape digital health innovation generally. In proposing human-centred design as a means of addressing these complexities, we highlight important conceptual and philosophical links with good governance interventions, the former influenced by Scandinavia's participatory design movement and the latter by the participatory global development community.

Finally, Appendix IV features the abstract of an article titled Design and Implementation of an Open Source ‘Thin SIM’ System for Collecting Data & Supporting Global Health Care. Published in the ACM Symposium on Computing and Development, this paper describes a system for building simple data collection applications that run on a paper-thin SIM card which slides underneath a phone’s ordinary SIM card in the same SIM slot, enabling structured data collection on widely available \$15 phones. We argue that SIM apps merit consideration as part of a configurable digital toolkit for supporting global health and ICT4D initiatives. Moreover, we argue that relative to beginning with a single technology and looking for contexts that might (be made to) fit it, beginning with an open toolkit supports a more human-centred way of initiating data collection activities.

These appendices share two substantive themes in common. First, they are topically related to one another and to the bulk of this dissertation in that they address ICTs, human-centred design and global health. Second, they are multi- or trans-disciplinary endeavour’s in that they draw on work from several disciplines and have been tailored to the disciplinary communities in which they were published. Appendix II is centrally concerned with a pragmatic opportunity to improve cancer care; it does not offer the conceptual or empirical contributions that would be expected of work published in information systems or organization studies journals. Appendix III uses a systematic method of reviewing that is well established in the medical community and frames its contribution in terms of what is novel and important in global public health, rather than orienting to the organization and information systems literatures. Appendix IV emphasizes the design and creation of a novel digital system as the primary contribution to learning, an approach common in engineering but not widely accepted in this dissertation’s primary disciplinary home.

By including these articles, I offer further perspective on the reach and contributions to learning of my whole course of study at Cambridge. They are at least potentially

relevant in light of university guidelines,¹¹ which state that “PhD, MSc and MLitt degrees (research degrees) are not awarded in any particular subject, and the certificate makes no mention of the subject area.” However, I include them only as appendices on the grounds that in this particular case, in relation to the papers I have featured as the three core chapters, they would not present a sufficiently connected account. Despite clear topical overlap, they do not orient to the same literatures or reflect engagement with the process of peer review in the same disciplinary home as these other articles. In the core chapters I have endeavoured to anticipate, discover and respond to specific criticisms, sustaining an ongoing argument within a recognizable disciplinary community. In the appendices I have established the legitimacy of several contributions to learning by pursuing arguments in other dispute domains. It is in this sense that the portfolio format may reflect engagement with the exigencies of peer review, including the unavoidable fact that reviewers often draw papers in their own directions, and yet still present a connected argument in a manner that can only be accomplished through the portfolio format.

1.6 Bringing it all Together: A Three Fold Practice Dissertation

Running through this introduction are three interrelated yet conceptually distinct notions of practice. The first of these concerns the practices of practice theory, a distinctive yet heterogeneous, lively branch of social theory. This is the treatment of practices one expects to find in a manuscript’s Theory section. It is abstract and highly generalizable. In most cases it explains how any bundle of ordinary activities may relate to the production and durability of patterns of organization and social life. It also will orient the researcher to studying practices in real time and with the passage of time, for people typically do far more than they are able to recall or articulate in retrospective interviews. This notion of practices informs the dissertation as a whole and is explored at length in Chapter Two.

¹¹This is from the same University guidelines cited previously:
<http://www.cambridgestudents.cam.ac.uk/your-course/examinations/graduate-exam-information/submitting-and-examination/phd-msc-mlitt>

A second notion of practice builds on and yet casts a critical light on the first. This view of practice is predicated on performing the phenomenon of study. I use this notion in reference to Wacquant's general approach to enactive ethnography (2015) and in particular his apprenticeship-based study of boxing as a plebeian bodily craft (2004). My perspective has also been shaped by books such as *Pathologies of Power* (Farmer 2004) and *Fresh Fruit, Broken Bodies* (Holmes 2013), in which physician anthropologists make skilled and practical caring for the sick and suffering central to their mode of ethnographic inquiry. Following Wacquant, I call this a view from practice rather than a spectator's study of practice. It involves participating in a manner that cultivates and employs concrete skills, rather than merely shadowing people as has been more common in organizational ethnography.

To some degree this is a treatment of practice one expects to find in a manuscript's Methods or Methodology section. Yet there are clear differences not only in the way findings are produced but also, quite often, in the content of those findings. Performing the phenomenon of study can illuminate the tacit dimension of practice and highlight the author's standpoint. While Chapter Four develops this perspective from practice most explicitly, it can also be read into this chapter's discussion of the jumping-off points for this dissertation—my discovering digital health and beginning an ongoing apprenticeship in human-centred design. We see another justification for this approach, albeit a less explicit treatment of the of/from distinction, in Chapter Three:

Assisting with various tasks enabled the researcher to build rapport and gain invitations to significant conversations and journeys to remote clinics that would have been far less accessible to anyone perceived as an outsider. Additionally, as Walsham, Robey and Sahay (2007) argue, researcher participation in projects of technology development and use is “particularly relevant in contexts where resources are scarce, when it can be argued that outside researchers should not only go away with data for their academic papers, but should also aim to make a contribution in the research setting itself.”

As tools for organizing and reflecting on fieldwork, these practice perspectives have shaped this dissertation's core contributions to learning. My particular contributions relate to the orientation to theory that I call 'room for silence,' designing for the emergence of sociomaterial practices, sensemaking in the flesh and a substantive notion of what it means to be 'human' centred. Taken together, these contributions advance a practice perspective on the interrelated processes of sensemaking and human-centred

design. While I have studied widely, I have developed this perspective through ongoing scholarly debate in a particularly disciplinary home among students of digital innovation and organizational ethnography. As I argued previously, this might be enough to read these chapters as a connected argument. If we justify the portfolio format on the grounds that it affords more substantive engagement with the process of peer review, it follows that matters of scope, quality and the extent to which the dissertation presents a connected account should be considered in light of the exigencies of peer review.

Yet there is an additional sense in which these contributions are related. This is that they are preoccupied with hoping to seem credible, legitimate and relevant for practitioners who address matters of real human concern in remarkably complex and demanding situations. This is the reference to practice that we might expect to find in the Discussion or Conclusion sections of a manuscript. This view of research for practice does not treat practice as a mere empirical concern, in the sense that Feldman and Orlikowski (2011) recognize as emphasizing the centrality of people's actions and "the importance of human agency in producing organizational reality without explicitly drawing on practice theory or practice philosophy." What I am calling research for practice may well engage with practice theory, yet it is clearly guided by the aim of corresponding with practitioners in a manner that most studies of and from practice are not. One hardly expects Wacquant's fellow boxers to read his text and incorporate it into their ongoing practice in the manner that I hope my fellow human-centred designers will do with my Chapter 5. This is why Chapter 5 has been de-jargonized and re-oriented so as to be co-authored with, read and discussed by practitioners and policy makers. It is this third notion of practice that I ask readers to consider as they read this portfolio, for I will return to it and develop it further in the concluding chapter.

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2 ROOM FOR SILENCE: PLURALISM AND THE PRAGMATIC STUDY OF SOCIOMATERIAL PRACTICES

Isaac Holeman¹²

This essay concerns efforts among practice theorists to recast “the social” and “the material” in everyday life, challenging the separation of technology, work and organization. In this broad view, materiality refers not only to the physical properties of machines but also to software and algorithms, electrical grids and other infrastructure, buildings, roads, human bodies etc. Drawing on feminist perspectives in science and technology studies, the term sociomaterial practice speaks to a view of recurring activity

¹² While I am the sole author of this article, special appreciation is due to my supervisors Michael Barrett, Mark de Rond and Jennifer Howard-Grenville, and to Wanda Orlikowski whose annual Judge Business School seminar on the process of theorizing greatly shaped this essay. I am also grateful to participants in the Theory Transfers workshop at CSCW '17 who offered feedback on a shorter version of this text. While my initial dissertation proposal to conduct fieldwork in Liberia was cut short by the Ebola outbreak, I am grateful to my global health colleagues whose informal insights from the field have informed this analysis.

in which people and materials are generative and analytically inseparable, being always already entangled. Despite remarkable enthusiasm for the notion of sociomaterial practices, the discourse occasionally has devolved into philosophical turf wars, engendering pleas for pluralism. On the other hand, some see the discourse as irrelevant to pragmatic concerns such as design work. This essay traces both issues to a tension between adopting a general philosophical Ontology and undertaking empirical studies of particular concrete practices. I argue that explorations of particular sociomaterial practices should be granted room for silence with respect to some theoretical and Ontological commitments, on the grounds that this will afford a more robust and lively pluralism. For the ethnomethodologically inclined, this re-orientation to grand theory is a matter of methodological rigor and theoretical sophistication. For the pragmatically inclined, room for silence has to do with the dilemma of rigor or practical relevance. Through a brief account of the 2013-2016 Ebola outbreak in West Africa, I argue that granting room for silence is particularly important if sociomaterial perspectives are to find purchase in the pragmatic work of designing human-centred systems in complex and challenging situations.

2.1 Introduction

*In the varied topography of professional practice, there is a high, hard ground where practitioners can make effective use of research-based theory and technique, and there is a swampy lowland where situations are confusing “messes” incapable of technical solution. The difficulty is that the problems of the high ground, however great their technical interest, are often relatively unimportant to clients or to the larger society, while in the swamp are the problems of greatest human concern. Shall the practitioner stay on the high, hard ground where he can practice rigorously, as he understands rigor, but where he is constrained to deal with problems of relatively little social importance? Or shall he descend to the swamp where he can engage the most important and challenging problems if he is willing to forsake technical rigor? Donald Schön, *The Reflective Practitioner* (1983)*

While Donald Schön addressed professional practitioners in this classic statement on the dilemma of rigor and relevance, few would doubt that scholarly communities also tend to form their own views of the “high, hard ground.” For practical purposes we could not possibly advance every argument from first principles. Instead, we tend to publish our work for communities that share enough in empirical interest, methodological norm, theoretical perspective and standard of rigor to streamline the difficult work of advancing knowledge. Weinberg (2002) calls these relatively bounded

communities “dispute domains,” and emphasizes that they can be located socially and politically. Tracing how they have changed historically is one way of recognizing that they are still changing today, in light of fresh concerns and with more or less allegiance to particular traces of disciplinary genealogy. Our standards of sophistication and rigor are always up for debate, and the academy’s relevance to the wider world hangs in the balance.

In this essay I consider how this dilemma may apply to recent efforts among practice theorists to recast “the social” and “the material” in technology studies, challenging the presumed separateness of technology, work and organization. In this broad view, materiality refers not only to the physical properties of machines but also to software and algorithms, electrical grids and other infrastructure, buildings, roads, human bodies etc. Drawing on feminist perspectives in science and technology studies, the term sociomaterial practice speaks to a view of recurring activity in which people and materiality are always already entangled and analytically inseparable. In this regard, it speaks to the nature of practices and what some have called the “ontological turn” in social theory (Lynch, 2013; Mol, 1999; Woolgar & Lezaun, 2013).

In recent years, foundational work by Orlikowski (2007) and Orlikowski and Scott (2008) has sparked a surge of sociomateriality papers and conference activity spanning information systems, organization studies and CSCW. This was followed by attempts at elaboration and clarification that have been enlightening at times and in other cases devolved into acrimonious turf wars (Mutch 2013; Scott & Orlikowski 2013). One can hardly say the word ‘sociomaterial’ at academic conferences without being asked by audience members to clarify whether one is a sociomaterial radical (i.e. an advocate of the philosophy called agential realism) or a sociomaterial conservative (i.e. a philosophical critical realist) (Niemimaa, 2016). This essay is critical of attempts to recast the study of sociomaterial practices as a kind of sociomaterial-ism; as a grand “theory of everything” rooted in a singular and totalizing philosophical Ontology. Such efforts have engendered urgent cries for pluralism (Scott & Orlikowski, 2013) and more than a little frustration with, to use George Orwell’s expression, the smelly little orthodoxies of the day.

At the same time, some see the increasingly philosophical bent of the sociomaterial practice discourse as impenetrable or irrelevant to practical concerns such as empirical

inquiry and concrete design work. While design research and the literature on sociomateriality share a common interest in the material, they emerge out of different academic traditions. Some have begun forming a practical interventionist design agenda based on the study of complex sociomaterial practices, but they acknowledge that “some might claim that the two are epistemologically so far from each other that it is not possible to unite them.” (Bjørn & Østerlund, 2014, p.7).

The central argument of this essay is that pluralism and practicality are related, and that they might both be addressed through an orientation to theory that I will call room for silence. I develop this notion based on a scene recounted in the essay *Silence in Context: Ethnomethodology and Social Theory*, in which Lynch (1999) describes the prominent ethnomethodologist Harvey Sacks taking questions after a public lecture in 1975. One man reportedly asked, “if I put a gun to your head, and asked you to name the theorist who had the most influence on your work, who would you mention?” Lynch continues:

Sacks was smoking a cigarette (which was permissible in the US at the time). He paused. With head down, and his cigarette at the lip of an ashtray, he held the pause while periodically flicking the ashes. This went on for a minute or two. The pause seemed endless at the time. To say it was a pregnant pause was not enough. This pause had time to give birth and raise a family. At long last, Sacks looked up and quietly declined to answer the question... As Sacks himself has taught us, silence is an accountable mode of communicative action, and this silence surely was a vivid instance of such action. Sacks did not simply fail to answer the question. His long pause was not merely the absence of an answer. It was a studied, and instructive, silence (p. 211-212).

This essay explores this kind of silence, in terms of its consequences (what it makes room for) and its theoretical sophistication or rigor. To this end, I trace a web of connections from design research and pragmatic philosophy to ethnomethodology in the latter half of the twentieth century. From there our line of inquiry zooms out to consider this work as part of the broader turn to practice in social theory. Following Nicolini (2012b) and Kuutti and Bannon (2014), I argue that practice approaches are obviously heterogeneous, yet nonetheless bear a remarkable family resemblance by which we can distinguish them from alternative psychological, economic and sociological theories. I then argue that this notion of family resemblance is sufficient, not to mention more nuanced than lists of required conceptual elements or categorical debate, for distinguishing the sophisticated study of sociomaterial practices from other

perspectives on practice or “the social.” This nuanced gauge of what constitutes sophisticated or rigorous practice theorizing is the basis for what Nicolini has called programmatic eclecticism or toolkit pluralism in practice based studies (2012a).

Embracing a particular implication of the toolkit approach, I argue that pluralism in the study of sociomaterial practices, like pluralism in the broader practice turn, must be sweeping enough to grant researchers room for silence with respect to some theoretical and Ontological commitments. I embrace Walsham’s (2005) call to let “a thousand theoretical flowers bloom” in our understanding of human and machine agency, and then go one step further by welcoming ethnomethodological and pragmatic scepticisms of theoretical abstraction. For the ethnomethodologist, remaining silent with respect to generalizable abstractions is a matter of methodological rigor and theoretical sophistication; for the pragmatically inclined it speaks to the dilemma of rigor or relevance. If empirical studies of sociomaterial practices are not granted room for silence with respect to the adoption or advocacy of a philosophical theory of all objects, this nascent conversation might fall short of its potential to address matters of real human concern. To underscore this final point, I illustrate the real human stakes of ontological debate through a brief empirical case, that of the 2013-2016 Ebola outbreak in West Africa.

In conclusion this essay offers two distinct contributions. By reflecting on the notion of room for silence in light of the empirical case, I suggest a way forward for sociomaterial perspectives to find purchase in the pragmatic work of designing human-centred systems in complex and challenging situations. Of more general scholarly interest, the notion of room for silence modestly refigures the conceptual map of the sociomaterial practice discourse, thereby inviting the reader to a more robust and lively pluralism.

2.2 Design and Reflective Practice

Even on a cursory inspection, just what design thinking is supposed to be is not well understood, either by the public or those who claim to practice it (Kimbell, 2011, p. 286).

Exploring sociomaterial practice in terms of its pragmatic relevance to design work is challenging, in part, because the conceptual terrain of design practice, design thinking and human-centred design is not at all fixed or coherent. Buchannan (1992) remarks

that “neo-positivism, pragmatism, and various forms of phenomenology have strongly influenced design education and practice in the twentieth century. If design theory has often tended toward neo-positivism, design practice has tended toward pragmatism and pluralism, with phenomenologists in both areas.” Bannon and Ehn (2013) offer a similar outline: “The two main approaches discussed in the design field are the rational problem-solving model and the reflective practice paradigm.” They observe that Simon’s neo-positivist view of the designer as rational problem-solver in *The Sciences of the Artificial* (1996) has had a major impact on the design research community. Nonetheless, Schön’s pragmatist-inspired view of the designer as reflective practitioner has been far more influential in some circles, including the art and craft-oriented design professions, participatory design and CSCW. With over 50,000 Google Scholar citations and a wide practitioner audience, Schön’s (1983) book *The Reflective Practitioner* is possibly the most influential work of design scholarship ever published.¹³

Schön describes design as a reflective conversation with the materials of the situation. He introduces a case in architectural design (1983, p. 76) by first noting that the process of making is typically complex, that the designer’s moves are likely to have intended and unintended consequences. The course of design work emerges in practice, at least in part, because the designer cannot fully predict or control how the concrete materials of the situation will respond to her initial moves. The designer shapes a situation in accordance with her initial perception of it, the situation “talks back,” and she responds to this material back talk with new moves or actions. Materiality is generative, and the human actor is generative and artfully adaptive, in this analysis.

Schön contrasts our reflection-in-action with conscious reflecting on action by observing that our knowing-in-action is normally tacit, “implicit in our patterns of action and in our feel for the stuff with which we are dealing” (1983, p. 49). In reference

¹³ Given this dissertation’s location at the intersection of organization, information systems and design research, it bears mentioning that many refer to Schön as a design scholar because his influence has been sweeping in the design research community as a whole, more so than his not insubstantial influence in organizational theory, education, HCI, sociology or philosophy. Nonetheless, Yanow and Tsoukas (2009) describe Schön as an organizational scholar. Given his major publications on organizational learning and manager behaviour and his consulting practice at Arthur D. Little and his own firm OSTI, there is credence to both views.

to the work of Michael Polanyi (2009) and others, he suggests that the manner in which we reflect-in-action has a similarly tacit dimension. Through cases as diverse as baseball pitchers and jazz musicians he emphasizes that,

When good jazz musicians improvise together, they also manifest a “feel for” their material and they make on-the-spot adjustments to the sounds they hear... we need not suppose that they reflect-in-action in the medium of words. More likely, they reflect through a “feel for the music” which is not unlike the pitcher’s “feel for the ball” (1983, p. 55-56).

While Schön calls for us to rediscover the artistry in professional work, he deals in a nuanced way with cases in management, science-based professions such as engineering, and with broader human concerns such as malnutrition in Colombia. In this way Schön develops a general theory of reflective practice that is highly attuned to cases of designing, but not focused narrowly on design as a discipline or domain of professional practice.

Schön does not discuss pragmatic philosophy in any direct or extended fashion in *The Reflective Practitioner*. However, it is widely recognized that Schön’s PhD in philosophy concerned Dewey’s theory of inquiry and that this conceptual legacy is apparent in Schön’s subsequent work. For Dewey (Dewey, 1925; Dewey, 2005), all creative and investigative activities involve a similar process of disciplined inquiry that is neither step-wise nor algorithmic nor entirely cerebral. Experiencing perplexity in concrete situations, pursuing on-the-spot experiments and learning-by-doing are central to the pragmatist view of intelligence and understanding.

One might further attribute Schön’s tendency to neglect discussing theory for the sake of theory to his pragmatic bent, given that pragmatists tend to view abstraction as inevitably distorting concrete lived experience. However, this has also left room for many scholars to read notions of reflective practice in light of other, more theory-heavy works. For example Levina (2005, p. 112) holds that “reflection-in-action is essentially a structurational, practice-based concept,” referring her readers to the work of Giddens (1984) and Bourdieu (1977). Yanow and Tsoukas (2009) suggest that we reread reflection-in-action in phenomenological, in particular Heideggerian terms. In his impressive ethnography of photocopy repair work, Orr’s (1996) two central, intertwined analytical constructs are reflective practice and “situated action.” The latter refers to Suchman’s (1987) influential book *Plans and Situated Actions*, which draws heavily on

ethnomethodology. Ethnomethodology, phenomenology, structuration and praxeological scholarship—to identify what these diverse theoretical discourses have in common, we might say that they are all theories of practice.

Many researchers orient their investigations based on one of these schools of thought, and design researchers in particular have drawn more heavily on some schools than others. For example, there is a lively body of ethnomethodologically informed, design-oriented studies of computer supported cooperative work that builds on Suchman's contributions and related work (Schmidt & Bannon, 2013). However, the notion of a turn to practice in social theory invokes the body of work as a whole. I will show later that pluralism in the turn to practice, that is to say the practical relations among the schools of practice theorizing, is an explicitly recognized feature of the conceptual terrain from which the sociomaterial practice discourse emerged. Thus if we are to trace links between pragmatic design issues, pluralism and the study of sociomaterial practices, we must first examine the nature and limits of pluralism in practice-based studies more generally.

2.3 Pluralism in Social Theory's Practice Turn

Theories of practice emphasize recurring activity and the concrete details of how people perform their daily work, with a processual and relational view of social phenomena as ongoing accomplishments. They locate 'the social' not in individual choices or social norms but in concrete practices, which Reckwitz (2002) describes as "routinized forms of bodily activities, forms of mental activities, 'things' and their use, a background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge" (p. 249). In ordinary use the word practice may simply refer to how people work. Practice theories generally also hold that a practice "forms so to speak a 'block' whose existence necessarily depends on the existence and specific interconnectedness of these elements, and which cannot be reduced to any one of these single elements" (Reckwitz, 2002, p. 250).

Nicolini (2012b) identifies six important bodies of practice theory: the 'praxeology' of Bourdieu and Giddens, practice as tradition and community, Marxist perspectives on practice as activity, practice as accomplishment in the ethnomethodological tradition, conversation or discourse as practice and Heideggerian and Wittgensteinian views of

practice as “the house of the social.” While these schools of thought are obviously diverse, Nicolini makes a compelling argument that they nonetheless bear a recognizable family resemblance. Like Nicolini, I use the term family resemblance in reference to Wittgenstein’s observation that we do not typically recognize the relatedness of things such as games or the faces of family members based on any one essential common feature. Rather, they are connected by a series of overlapping similarities which typically are clearly recognizable, even if we cannot identify a single feature shared by all. This observation bears extended reflection because it is the logical basis of pluralism for many practice scholars. It would be myopic to consider only the differences between various streams of practice theorizing, if we did not first recognize that their common vision of *homo practicus* is clearly distinguishable from the highly rational *homo economicus* and the classic functionalist *homo sociologicus*.

According to Feldman and Orlikowski’s (2011) lucid introduction to practice theorizing in organization studies, the common vision includes: “(1) that situated actions are consequential in the production of social life, (2) that dualisms are rejected as a way of theorizing, and (3) that relations are mutually constitutive.” Writing for an HCI audience, Kuutti and Bannon (2014) offer a compatible summary but foreground different themes, paraphrasing Nicolini (2012) as follows:

- 1) A process and performative view on social life: structures and institutions are realized through practices; practices are local and timely and they have histories.
- 2) The critical role of materiality of human bodies and artifacts; there are no practices without them.
- 3) A different role of agency and actor than in traditional theories: ‘*homo practicus*’ is both the bearer of practices in his or her mind and body, and the one who produces the practices in action.
- 4) Seeing knowledge as a capability to act in practices in meaningful and productive way.
- 5) The centrality of interests and motivation in all human action and a corresponding focus on power, conflicts and politics.

In outlining similarities that run across theories of practice, these authors do not claim to offer a new meta-theory so much as they draw attention to collective movement that has been growing momentum for decades. For example Kuutti and Bannon (2014) trace the turn to practice in HCI by first observing that since at least the 1990s Giddens’ (1984) structuration theory has influenced information systems research,

ethnomethodology has gained prominence in CSCW and activity theory and phenomenology have been important in participatory design. Each of these communities subsequently interlaced with HCI in important ways. Over time, many scholars have begun deliberately switching among these kindred theoretical sensitivities in order to better grasp distinctive features of particular phenomena. This is not to say that there has been any attempt to systematically unify or homogenize practice theories conceptually. Rather, drawing on a toolkit of practice concepts and sensitivities, while committing to “hold our tools lightly” (Weick, 1996) has become a matter of course for many practice scholars in work, technology and organization studies. Nicolini calls this “programmatic eclecticism,” a “collage or heteroglossia, or even carnivalesque approach,” or more simply, a “toolkit approach” (2012a, p. 213-215).

2.3.1 Ethnomethodology and Pragmatism as Test Cases for Theoretical Pluralism

Ethnomethodology poses an important test for this toolkit pluralism, for it stands apart from practice theories that posit a conceptual map or explanation of practices. Ethnomethodology revolves around a particular order of phenomena which it calls ethno-methods, the practical methods or activities through which ‘ethnos,’ culture or ways of life are accomplished. However, ethnomethodologists reject accumulating systematic knowledge of the general characteristics of ethno-methods. While ethnomethodology does have key concepts (e.g. accountability, reflexivity, indexicality, membership), Lynch (1997, p.18) likens these concepts to “a ticket that allows entry into the ethnomethodology theatre, and is torn up as soon as one crosses the threshold” of empirical observation. For this reason, they argue that practices should always be theorized through empirical examples and detailed descriptions rather than as instances of habitus, an activity system or other generalizable practice concepts. Practically speaking, this scepticism of abstract theory has often resulted in methodologically painstaking and analytically rich work that some classically trained sociologists regard as offering “no contribution to theory.” Ethnomethodology is not alone in viewing abstractions as distortions of ordinary life, however. It shares this inclination with pragmatism, and given our interest in linking pluralism to pragmatic implications for technology design, the commonalities between ethnomethodology and pragmatism bear further exploration.

In a recent paper on values in technology repair, Houston and colleagues (2016) review “traditions of ethnomethodology and conversation analysis which are pragmatism’s most obvious jumping off point into HCI.” The conceptual parallels between pragmatism and ethnomethodology also have been explored extensively beyond technology and design studies. The cursory outline here follows the analysis of Emirbayer and Maynard (2011). They argue that pragmatism emphasized the importance of empirically validating philosophical concepts in terms of their practical consequences, but never developed a methodological program through which to actually do so. In contrast, ethnomethodology established a tradition of theoretically informed and empirically rich research that has developed several core themes of the original pragmatist impulse.

The first of these themes is the call for a return to lived experience. The classical work of Pierce, James, Mead and Dewey calls for a recovery of concrete practices. They are deeply critical of a tendency in Western science, across the natural and social sciences, to direct scholarship away from the particularities of lived experience and toward generalizable theoretical abstractions.¹⁴ This focus is apparent in the pragmatic maxim: “Consider what effects, which might conceivably have practical bearings, we conceive the object of our conception to have. Then, our conception of these effects is the whole of our conception of the object” (Peirce, 2009, p.132). In other words, ideas should be understood in relation to practice; concepts or debates that cannot demonstrate practical relevance to concrete experience are in this view deemed “idle.” James would later say, “the whole originality of pragmatism, the whole point of it, is its concrete way of seeing. It begins with concreteness, and returns and ends with it” (1981, p. 281-82). Ethnomethodology carries this theme forward through a distinctive focus on how practices are accomplished in real time, or as Boden put it, “understanding the world as it happens” (1990). Ethnomethodological studies avoid overly generic representation, focusing instead on the particularities of ordinary talk and bodily practice in concrete situations.

¹⁴ For a recent analysis of how the abstracting tendency of “scientific rationality” differs from the logic of daily practice, situated not in pragmatist terms but as part of the broader pluralistic practice turn in organization studies, see Tsoukas and Sandberg (2011).

A second theme of mutual concern has to do with how doubt, perplexity, ‘back-talk’ or disruption are experienced in concrete practice. In the pragmatist view, most daily activities are unreflective and routinized, and such recurrent behaviour is consequential in the production of social life. However, it is only when habitual activities are disrupted by a sense of doubt or perplexity that actual thinking or problem solving typically occur. As Cooley put it, “the test of intelligence is the power to act successfully in new situations” (quoted in Emirbayer & Maynard, 2011, p. 228). In this regard Schön’s (1983) analysis of material back talk triggering reflection-in-action clearly resonates with Suchman’s (1987) analysis of how people encounter unanticipated situational difficulties that disrupt plans or working assumptions and engender “situated action.” In fact, the pragmatist attention to how obstacles in experience give rise to efforts at creative problem-solving might well be described in Suchman’s terms as “the problem of the situatedness of action.”

It bears mentioning that to some degree, Garfinkel developed ethnomethodology against the pragmatism that had dominated and was just being eclipsed in American sociology during his early scholarly development. Ethnomethodology is no mere application of pragmatist thought, far from it (Rawls, 2010). Nonetheless, Emirbayer and Maynard (2011) argue persuasively that ethnomethodology advances the “unfinished business” of pragmatism.¹⁵

I should also note that pragmatism is conspicuously neglected in Nicolini’s book and some other literature reviews that summarize the schools of thought that have contributed to contemporary practice theorizing (Feldman & Orlikowski, 2011; Kuutti & Bannon, 2014; Sandberg & Tsoukas, 2011). A plausible explanation of this neglect can be found in the introduction to Nicolini’s book:

¹⁵ For a parallel in design scholarship, some readers will recall that the Scandinavian tradition of participatory design was initially formulated as a political critique of sociotechnical design, the latter having assumed a more consensual model of worker-manager relations. In the following decades, many proponents of sociotechnical design embraced the emancipatory aims and methods that animated Scandinavian design (Scacchi, 2004). At the same time, it is difficult to discuss the development of the Scandinavian tradition without explaining the lasting influence of socio-technical systems thinking (Bannon & Ehn, 2013). Thus in hindsight and through comparison with design frameworks that are less interrelated, two approaches that formed in opposition to one another have come to be seen as cousins.

It would be a mistake, of course, to limit responsibility for this major turn of social theory to the three above-mentioned traditions [Marxian, Heideggerian and Wittgensteinian thought]. In fact, particularly in the USA, this emerging sensitivity was built upon the strong traditions of pragmatism and symbolic interactionism that had kept alive the regard for action and interaction during the period in which European thinkers had been seduced by all forms of functionalism and structuralism... One may say that the so-called 'practice turn' has not been notable within North American social thought simply because an attention to practice and doing has always been very much present. This is thanks to the legacy of the pragmatist tradition among philosophers and social scientists... In this sense my work should probably be recast as an attempt to make a Continental history of the concept of practice (2012b, p. 41).

With these similarities and differences in mind, my aim in reviewing the connections between pragmatism and ethnomethodology is threefold. First, as a test case for the limits of toolkit pluralism, openness to ethnomethodology suggests that ways of theorizing practice through empirical research may be taken as seriously as the corpus of theories proper (i.e. textual representations of abstract generalizable concepts that describe or explain practices). Pragmatically inclined studies are often seen as part of the practice discourse on similar grounds. Ethnomethodology and pragmatism are sceptical of the kind of abstraction that characterizes other theories of practice. Yet the toolkit pluralism of Nicolini and many others recognizes relations with these schools of thought on the grounds that they bear a recognizable family resemblance.

Second, there is a common misconception that pragmatic thought was not merely eclipsed but was wholly repudiated in philosophy and social science around the time of WWII, with the rise of analytic philosophy and professionalization and de-politicization of American sociology. An alternative view holds that pragmatic preoccupations were often carried through in later work, even in studies that more explicitly embraced Goffman, Garfinkel, Wittgenstein or others. One may well decline to identify with pragmatist philosophy, even while theorizing cases in a manner that takes seriously the pragmatic concern with the dilemma of rigor and relevance.¹⁶ In some corners the

¹⁶ For example Hacking (1998, p.93) writes, "one of the few domains in which I am a consistent pragmatist is pragmatism itself: use it when it is useful, but don't when it isn't." In a later essay titled On Not Being a Pragmatist, Hacking (2007) writes glowingly of William James, while offering eight reasons for not identifying as a pragmatist (without necessarily rejecting key pragmatic notions). He begins with a historical explanation that could not be more apposite to my own experience: "Things might have been

recent pragmatic revival is driven by efforts to recover the tradition of social science that concerns the social good and engages directly in meliorist projects of social critique and social reform (Wilkinson & Kleinman, 2016). For example, the pragmatist and social reformer Jane Addams is being reclaimed as a founding figure in American sociology, in light of growing recognition that her research was widely influential at the time of publication and that efforts to exclude her contributions from the sociological canon were politically motivated (Wilkinson & Kleinman, 2016, p. 163). The pragmatist and administrative theorist Mary Parker Follett has also seen renewed interest in recent years, with a new preface to the 1998 re-printing of her 1918 book *The New State* remarking that neglect of her work probably cannot be separated from her having been “an exceptional woman in a world largely owned by men” (1998, p. xvi).

The third reason for reviewing the links between pragmatism and ethnomethodology is that these traditions have influenced design theory and practice enormously in the last half century. In recognizing that Schön’s vision of design as reflective practice bears an unmistakable family resemblance to Suchman’s notion of situated action and other practice scholarship, we have located an important stream of design research in relation to the sociomaterial practice discourse that I will review in the following section.

2.4 Sociomaterial Practices

Despite widespread recognition that people and technology are at play in most organizational phenomena, Jackson, Poole and Kuhn (2002) observe that many accounts exhibit a “tendency to tilt,” focusing narrowly on one and neglecting the other. As a result, such studies may implicitly promote a light form of either technological determinism or social determinism. Leonardi and Barley (2008) suggest that disregard

different had I begun my formal study of philosophy in the United States. Instead, I began at Cambridge University, where I did a two-year B.A. in moral sciences after studying mathematics and physics in Canada. America would have been a different experience. But not because I would have learned about pragmatism: on the contrary, because I would have been educated in the shadow of logical positivism. Hence I would have discovered pragmatism as rebellious liberation. I had a wholly eccentric education... Wittgenstein had recently died. One absorbed a good deal of the man, and had the incomparable advantage of never attending a lecture in which his name was mentioned. Instead, he was internalized.”

for the causal influence of materiality in organizing may be a side effect of the decades-long confrontation with technological determinism, which is both deterministic and materialistic. By conflating the two, researchers intent on critiquing technological determinisms may have unnecessarily blinded themselves to the influence of material constraints and affordances. Latour (2005) suggests that this tendency has more to do with how researchers conceive of their remit (e.g. we are scientists of “the social”) than it does with the nature or inherent qualities of the topics they study. In other words, presumptions of separateness are a side effect of sociological ways of analysis, not an innate feature of concrete practices:

To distinguish a priori “material” and “social” ties before linking them together again makes about as much sense as to account for the dynamic of a battle by imagining, first, a group of soldiers and officers stark naked; second, a heap of paraphernalia—tanks, paperwork, uniforms—and then claim that “of course there exists some (dialectical) relation between the two.” No! one should retort, there exists no relation whatsoever between the material and the social world, because it is the division that is first of all a complete artifact. To abandon the division is not to “relate” the heap of naked soldiers with the heap of material stuff, it is to rethink the whole assemblage from top to bottom and from beginning to end (Latour, 2005, p. 75-76).

While such concerns had been percolating for some time, particularly in science and technology studies, Orlikowski struck a chord in 2007 with a provocative essay titled, Sociomaterial Practices: Exploring Technology at Work. She begins with the premise that materiality is inextricably bound up with everyday organizing and goes on to argue for studying sociomaterial practices in ways that recognize “the constitutive entanglement of the social and the material in everyday life.”

A year later Orlikowski and Scott (2008) undergirded this discussion of sociomaterial practices with an extensive review of research published by four leading organizational theory journals in recent decades. They observe that 95% of this research does not acknowledge the presence of technology, despite the obvious ubiquity of technology in organizational life. Rather than interpreting this trend as coincidence or mere oversight, they argue that it speaks to problems with how we have theorized the “social” processes of organizing as somehow separate from materiality. They then review studies that specifically concern technology and argue convincingly that most of this work can be grouped into three schools of thought. Reviewing their outline of these schools is important because it provides the basis for a discussion of the family resemblance that

characterizes each school. This analytical approach mirrors our discussion of the practice turn above and differs from the perspective of many later commentaries on whether there is “anything new” about the study of sociomaterial practices.

In the first school, technology is a discrete entity with inherent characteristics and it may be studied in terms of its diffusion or for how it interacts with social and organizational phenomena. Generally adopting a variance perspective that is amenable to statistical analysis, technology was often posited as an independent or moderating variable.¹⁷ In the second major school of thought, “technology is understood as part of the complex process through which organizing is accomplished” (Orlikowski & Scott, 2008, p. 446). In this processual view, the ways that people interact with technology are taken to change over time and from context to context. Technology and situated human activity are understood as mutually dependent and co-evolving.

This second school rejects the implicit technological determinism of the first school and it is more amenable to taking processes of design and emergence seriously. However, it nonetheless begins with the presumption that technology and ‘social practices’ are analytically and ontologically separate, before exploring how they relate to or influence one another. When technology and work are seen as first and foremost separate, it remains all too easy to write about social practices and organizing in ways that wholly neglect concrete materials, as if there were any companies that do not have to deal with technologies, buildings, infrastructure etc. On the other hand, even accounts of technology design, implementation or use often focus so narrowly on human activity that they neglect to describe the form of the technology itself or the manner in which its qualities might have shaped the course of affairs. Either way, concrete material “vanishes from view in the preoccupation with the social” (Orlikowski, 2007, p. 1437). For this reason, Orlikowski and Scott (2008) conclude that starting from a place of

¹⁷ While this paradigm has fallen from favour in organization studies, it remains alive and well in other disciplines that study technology. For example, much of the research involving digital technologies in lower income settings currently takes place in the nascent fields of mHealth, eHealth and digital health, which have their basis in public health and medicine and remain solidly within research stream I.

analytical separateness has engendered the problematic ‘tendency to tilt,’ even in the second stream of technology research.¹⁸

Addressing this problem is the central contribution of their 2008 paper, which is appropriately titled *Sociomateriality: Challenging the Separation of Technology, Work and Organization*. They argue that a third school of technology research is emerging and could be helpfully recognized with the umbrella term sociomaterial practice. This perspective rejects the view of actors and objects as essentially self-contained entities that have inherent properties before they have interactions with each other. Instead, it emphasizes that technologies saturate everyday activities and relations, it views sociomaterial practices as performing social and material relations together. This performative view takes the agency of material objects seriously, recognizing technologies and other concrete materials can and often do make a difference in everyday life. Thus materiality not only is integral to how practices are performed, it also may be generative in their ongoing production, shaping how they emerge or change over time.

In addition to reviewing technology research in organization studies, they highlight critical perspectives from feminist science and technology studies (Barad, 2003; Mol & Law 1994; Suchman, 2006), Pickering’s *Mangle of Practice* (1995) and Actor Network Theory (Callon, 1986; Latour, 2005). In this way they develop sociomaterial practice as an “umbrella term,” drawing attention to an emerging body of related works. Students of the practice turn more generally will be aware that the umbrella or toolkit approach is not new to their work; this may explain why they do not discuss pluralism at length. However, they do carefully observe (p. 462) that, “attempts to identify an encompassing, systematic ‘practice theory’ have largely given way to the suggestion that the concept of practice is most effectively used as a way of framing and orienting research (Schatzki,

¹⁸ Many studies in research stream II have drawn on theories of practice, such as Giddens’ theory of structuration. We will discuss later that Reckwitz’s definition of practices might better be seen as aligning with research stream III, the notion that practices are sociomaterial in nature. This is not to say, however, that practice-based studies which draw on Reckwitz’s definition should always be categorized in research stream III. What matters in Orlikowski and Scott’s analysis is how the author has theorized their particular data set; this categorization of the literature is *ex post facto*. It is based on observed presumptions of separateness in particular studies, rather than consideration of what is innate or possible with the theories of practice one references.

2001, p 4.).” Their account was explicitly more provocative than authoritative; they offered “some thoughts” about how research in this vein might be framed, “without wishing to preclude any approach to studying sociomateriality” (p. 463).

These two works sparked a surge of sociomateriality papers: Orlikowski and Scott (2008) has over 1,100 Google Scholar citations and Orlikowski (2007) has over 1,600.¹⁹ This success has engendered three trends which motivate this essay’s call for room for silence. The first is the flippant use of the term sociomaterial practice in ways that are not recognizably distinct from research stream II above. Some would even say that sociomaterial practice became a buzzword. Attendees of conference meetings such as the Agency, Materiality and Practice workshop at EGOS in 2014 will recall extended discussion of how and why the term sociomateriality was being used in writing that largely retained the citations and analytical tendencies of research stream II.

The second trend, which is in some respects a response to the first, has to do with efforts at theoretical clarification and elaboration. For example Jones (2014, p. 895) says of the recent surge of sociomateriality papers that, “only a few, however, address all of the notions that Orlikowski suggests are entailed in sociomateriality, namely materiality, inseparability, relationality, performativity, and practices, with many employing the concept quite selectively.” Such work is quite helpful when taken for educational purposes, as a critical response to sociomateriality trending as a buzzword. However, if taken as a definitional rulebook or list of required conceptual elements, it would strike some as more stifling than illuminating. It certainly would be more confining than the open-ended provocations of Orlikowski (2007) and Orlikowski and Scott (2008).

Whether explicit treatment of each of these notions is optional or required hangs in part on a discussion of whether there is “anything new” about studying sociomaterial practices. Many information systems researchers had already drawn on Actor Network Theory (Monteiro & Hanseth, 1996; Walsham & Sahay 1999) and the software tool and material approach (Ehn & Kyng, 1986; Ehn, 1988). The latter work is based on

¹⁹ Jones (2014) observes that almost all of the sociomateriality papers published in the information systems and organizational theory literatures cite Orlikowski (2007, 2010) or Orlikowski and Scott (2008), despite the fact that Orlikowski (2007) attributes the term sociomaterial practice to Mol (2003) and Suchman (2006).

Heideggerian phenomenology (Heidegger, 1996; Dreyfus, 1991), which has subsequently been recognized as a sophisticated philosophical basis for the study of sociomaterial practices (Sandberg & Tsoukas, 2011). Critical observers (e.g. Kautz & Jensen, 2013) have highlighted that sociotechnical systems theorists were critiquing the artificial separation of technical and social phenomena as early as the 1950s! As such Barley, Meyerson & Grodal (2011) write, “although one could use ‘sociotechnical’ as a synonym for ‘sociomaterial,’ we prefer the latter term because it has fewer historical connotations.” Even without the historical connotations of systems theorizing, we would do well to reconsider Reckwitz’s (2002) definition of practices, in which the integral components of human activity and various concrete materials were not to be analysed separately from the practice as a whole. Thus Jones (2014, p. 899) quite rightly observes that for careful students of Reckwitz, the term sociomaterial practices comes across as a tautology.²⁰

In light of these concerns, Jones (2014) suggests that sociomateriality is theoretically novel enough, but only if we attend to all of the five key notions which can be isolated from Orlikowski and Scott (2008). This orientation to abstract categorical novelty, as the basis for sophisticated or rigorous contribution to learning, conditions us to emphasize universal philosophical definitions in our treatments of sociomateriality. This is a markedly different tack than, for example, examining whether empirically grounded studies of particular sociomaterial practices bear a family resemblance that is recognizably distinct from research streams I and II. This definition-oriented tendency cannot be wholly separated from the third trend that merits our attention.²¹

²⁰ To be fair, Jones notes that Orlikowski and Scott (2008) cite Reckwitz’s definition of practices and the authors had done so repeatedly prior to these critiques, e.g. Feldman and Orlikowski (2011). It hardly seems likely that this tautology had not occurred to them. More likely, they were focused on the practical challenge of differentiating work that aligns with Reckwitz’s notion of practices from the studies of ‘social practice’ in research stream II, in which human activity (“the social”) was figured as analytically and ontologically separate from materiality. For the sake of such differentiations, meaningful tautologies are common in social theory, as in the term “lived experience.”

²¹ To be clear, I would caution against taking these trends in the sociomateriality discourse as having occurred chronologically, let alone as having caused one another. The Jones (2014) article was published after the debate sparked by Mutch (2013) and did not cause it. The latter two trends do not seem to have put an end to the flippant use of sociomateriality as a buzzword, yet they continue as if still more categorical debate would solve that particular problem. Thus these trends are interrelated and all three seem alive and well in 2017.

The third trend engendered by the sudden and striking success of the sociomateriality discourse is turf wars. In 2013 Mutch published a critical essay titled *Sociomateriality: Taking the Wrong Turning?* Recounting his full argument is beyond the scope of essay; I will only draw attention to the fact that Mutch favors critical realism and that his critique rests on taking the term sociomateriality as more or less synonymous with Barad's philosophy of agential realism (2003), which Orlikowski and Scott have favored in subsequent empirical studies of sociomaterial practices. Scott and Orlikowski's (2013) response to Mutch briefly defends their use of Barad's work, but in the main their response is an urgent plea for pluralism and openness in technology research: "If there is a measure of healthy scholarship then it is surely our capacity to sustain the conditions that foster openness and experimentation in the framing and doing of our research endeavours" (2013, p. 77).

Subsequently there have been many responses and responses to the responses; Mutch's essay now has over 100 Google Scholar citations. In one of the more widely cited responses, Leonardi (2013) argued that there is room for both agential realism and critical realism in studying sociomaterial practices. Critical realism is particularly suited to Leonardi's (2011) prior work on the metaphor of imbrication, which suggests "the gradual overlapping and interlocking of distinct elements into a durable infrastructure as one useful way to think about the process by which the social and the material become the sociomaterial" (Leonardi, 2013, p. 70). More recently Niemimaa (2016) explained the differences between sociomaterial radicals (agential realists) and sociomaterial conservatives (critical realists) with the aim of supporting a well-informed pluralism in which researchers avoid mixing perspectives into inappropriate "conceptual *mélanges*." In response to Niemimaa, Cuellar (2016, p. 60) argued that "critical realism is not properly part of the sociomaterial stream of research as it violates the five basic notions of sociomateriality (Jones, 2014)." Use of the term violate is noteworthy; it implies that Jones' (2014) five notions have ossified or been upgraded to the status of required conceptual elements, now commanding a stricter and more rule-based allegiance than may initially have been intended.

Contributions to these turf wars have generally been highly philosophical in tone, many offering no empirical material at all. While most tip their hats to Scott and Orlikowski's (2013) or Leonardi's (2013) calls for pluralism, to my knowledge none

substantively address the conceptual nature or practical quality of this pluralism. The pluralism that most of these papers take for granted is onerous. It forces the taking of philosophical ‘sides’ at the expense of relevance to practice, and as I will argue in the following section, it is not the only form of pluralism available to us.

2.5 Does sociomaterial invoke an Ontology or ontologies?

A pragmatic response to the criticism that there is “nothing new” about studying sociomaterial practices would be that concepts are tools and they are worth the work we are able to do with them. The evidence that the term sociomaterial practice has analytical purchase is to be found not only in the surge of citations but in the way that discussion of the term has helped to correct problematic trends in empirical research that Orlikowski and Scott (2008) documented in technology research streams I and II, and more generally in organization theory’s dearth of attention to technology. That is to say, sophisticated and rigorous studies of sociomaterial practices bear a family resemblance that is recognizably distinct from the manner of theorizing practices that characterizes stream II (even if some recent work in stream II flippantly uses the term sociomaterial). Whether we address the question of “what’s new” by debating general philosophies or debating features of particular empirical cases hangs in part on how we take the term sociomaterial to relate to the topic of ontology.

For the purposes of this essay, let us use the term Ontology to refer to the sort of philosophical theory of all objects that Pickering (1995, p. 246) forthrightly calls a “theory of everything.” Insofar as an Ontology (with a capitol O) such as agential realism or critical realism is developed in reference to empirical study, we might refer to it as an empirical philosophy. In contrast, let us discuss ontologies (all lower case) in reference to the nature and composition of particular historically locatable practices. A key difference is that we can more sensibly discuss ontologies in the plural. There are multiple kinds of things and practices in the world; for example, salmon are ontologically different in kind than sewing machines. In contrast, an intellectually coherent position can have only one Ontology. There is no universe in which Pickering’s (1995) mangle of practice fully co-exists with Barad’s (2003) agential realism

or with the critical realism of Mutch (2013). If taken in their full measure, such totalizing theories supersede comparable alternatives.²² In contrast, historical ontology in the tradition of Hacking (2002) tends to remain more grounded in concrete cases, as is the tendency for a great deal of empirical work in science and technology studies (Lynch, 2013) and medical anthropology (Livingston, 2012). If in doubt about whether a particular body of work is better understood as ontological or Ontological, any theory (or philosophy) branded as an “-ism” is likely of the more totalizing kind. In one sense, this essay explores whether Orlikowski’s (2007) seminal exploration of sociomaterial practices is being reformed as a kind of sociomaterialism. The shift appears to be well underway, as Orlikowski’s (2007) seminal paper explored sociomaterial practices, a year later Orlikowski and Scott (2008) discussed sociomateriality and some now write of a sociomaterialist perspective (Niemimaa, 2016).

If Leonardi (2013) and others are to be believed, it is entirely feasible to cultivate a research community or even an –ism in which there is respect for, or at least tolerance of intellectually incommensurable perspectives. Suppose one researcher studies algorithmically hybridized orange juice and another the cultivation of genetically rare heirloom apples. The orange researcher may embrace agential realism while the student of apples defends critical realism.²³ A healthy pluralism will grant that both studies should be potentially publishable, that their agreeing to disagree is a less bad option than disqualifying either party a priori. In practice this kind of pluralism has proven onerous; having been assigned peer reviewers from the competing branch of sociomaterial practice discourse remains a regular topic of handwringing and hushed corridor talk. Some anonymous reviewers are particularly blunt about which variants of sociomateriality “make sense,” suggesting that a kind of lip service pluralism remains all

²² Reckwitz (2002) underscores this distinction through reference to the German: “First of all, it is necessary to distinguish between ‘practice’ and ‘practices’ (in German there is the useful difference between *Praxis* and *Praktiken*). ‘Practice’ (*Praxis*) in the singular represents merely an emphatic term to describe the whole of human action (in contrast to ‘theory’ or mere thinking). ‘Practices’ in the sense of the theory of social practices, however, is something else. A ‘practice’ (*Praktik*) is a routinized type of behaviour which consists of several elements, interconnected to one other.”

²³ Coates (2007) does actually discuss critical realism and the perception of apples, and Wanda Orlikowski has occasionally presented about the sociomaterial practice of blending orange juice for consistent flavor throughout the year by using algorithms to source oranges in varying combinations from across thousands of orchards. She has not yet, to my knowledge, published on the topic.

too common. Nonetheless this position of pluralism-at-least-in-principle seems to be the consensus view of the sociomaterial practice discourse at the present time.

An alternative perspective would take these two example projects not as sweepingly generalizable (and therefore contradictory) studies of critical realism and agential realism but merely as studies of apples and oranges. Apples are different than oranges. Moreover, some apples may be ontologically different than other apples. Practical concerns such as designing digital procurement systems or even global trade deals that are fairer to heirloom apple orchardists may depend on whether we understand these differences through serious empirical research. Empirical arguments about the ontology of orange juice are unlikely to undercut pragmatic concerns about the ontological form of apples; it is only in the clash of Ontological philosophies that these studies may seem to discredit each other and engender urgent cries for pluralism.

The alternative tack of exploring ontologies and the multiplicity of practices runs close to the anti-monism of Mol in *The Body Multiple* (Mol, 2003). In a piece introducing the Japanese translation of her influential book (Mol, 2016), she explains that she was in some respects inspired by the story of a friend's relative who prayed at Shinto shrines in the morning and Buddhist temples in the evening. He found no apparent contradiction or tension in this habit because his religious practice was simply that, a practice, not systematic philosophy. In Mol's view, multiple kinds of practices often go side by side or tangle together in ways that universally generalizable and infinitely applicable philosophical positions cannot. As Lynch (2013, p. 446) puts this distinction, "an empirical treatment of topics associated with ontology should not be confused with the adoption or advocacy of a philosophical theory of objects." Some would say that this kind of anti-monism is vital for any lively and politically relevant pluralism. As one of the last century's most astute observers of pluralism wrote, it affords "the ideal of freedom to choose ends without claiming eternal validity for them" (Berlin, 2000, p. 242).²⁴

²⁴ In his classic essay on pluralism, Berlin goes on to argue that there are two kinds of freedom and that they are conceptually irreconcilable. The stubborn search for a "final solution" that reconciles them or determines which matters more is, he argues, a rejection of pluralism and the basis of totalitarian thinking.

For some, preference for Ontology or ontologies, for sociomaterialist stances or exploration of sociomaterial practices, will return us to the question of how contributions are judged to offer “anything new.” For example, doing field studies to investigate the production or ontological form of particular sociomaterial practices—say being homeless in a tech boom or breastfeeding in engineering workplaces or skipping school in a digital age—will be regarded by some as contributions to theory on those topics. Others will treat such work as merely empirical contributions, particularly if they have been primed to expect extended discussion of agential realism or some other –ism. Will our collective sense of finitude allow for writing about sociomaterial practices in both ways, or will the exigencies of peer review require Ontological contributions of grander stature? In other words, are we willing to grant researchers room for silence with respect to categorical Ontological debate?

By default, the question may seem like yet another matter for categorical debate. Categorical, definitional debate presumes that the one correct option will be found or, if agreement cannot be reached, the taking of sides will be inevitable. This presumption is unnecessary if we reframe consideration of Ontology and ontologies as at least partially a question of pluralism. With this reframing, we would not necessarily draw away from discussion of Ontologies. However, we would ask on what grounds we limit ourselves exclusively to the pluralism of taking sides when it is also conceptually sound and practical to see that some field studies are as incomparable as apples and oranges. In the following section I will argue that this more sweeping pluralism is necessary if we are to welcome contributions informed by ethnomethodology. That is to say, room for silence is necessary if the study of sociomaterial practices is to remain as pluralistic as the broader turn to practice from which it emerged.

2.6 Ethnomethodology and Room for Silence

Questions of what constitutes a robust enough theoretical contribution speak to how we understand rigor and regulate the porous boundaries of a scholarly dispute domain. As I suggested in the opening paragraph of this essay, such debate often involves selective homage, critique or neglect of particular aspects of disciplinary genealogy. Most recognize that the sociomateriality discourse emerged from within the practice perspective. Some even note the pivotal influence of Lucy Suchman, who introduced

many technology researchers to ethnomethodology in *Plans and Situated Actions* (1986) and to the notion of sociomaterial practices in the second edition of the same book (2006). For our purposes this genealogy is quite important. If there is any room for an ethnomethodologically informed study of sociomaterial practices, there must be room for silence with respect to categorical Ontological debate.

My notion of room for silence is based on a scene described by Lynch (1999) and recounted in the introduction to this essay. The prominent ethnomethodologists Harvey Sacks was asked, “if I put a gun to your head, and asked you to name the theorist who had the most influence on your work, who would you mention?” After a long and dramatic silence, Sacks quietly declined to answer the question. According to Lynch, “as Sacks himself has taught us, silence is an accountable mode of communicative action, and this silence surely was a vivid instance of such action.” Some readers will be unfamiliar with the terminology “accountable communicative action.” Sacks’ work on this matter (1992, Vol 1, p. 101) is worth exploring, but for our purposes suffice it to say that when silence is accountable in the ethnomethodological sense, people absolutely get the gist of what is being communicated.²⁵ Were a novice or nervous person to remain silent on stage, it might be less clear why they remained silent. But in other cases, in light of context, silence speaks volumes. In the curious case of Harvey Sacks on stage, one pictures a towering, magisterial silence.

To place Sacks’ silence in theoretical context, Lynch goes on to describe two terms that are central to ethnomethodology and that are of lasting relevance for the study of sociomaterial practices. The first of these is “unique adequacy.” While Garfinkel’s writing on this matter is deeply convoluted, Lynch draws our attention to the fact that people who have attained real mastery in a practice have necessarily discovered means of distinguishing competent performance from incompetence. These methods are typically unique to the practice in question. Competent doctors have unique perspective on how doctoring is accomplished, as do lawyers in judging the performance of fellow lawyers and designers in designerly ways of knowing. We might employ the standardized methods of professional sociology to understand the accomplishments of

²⁵ For a more recent, Wittgensteinian treatment of silence as communicative action, see Williams (2014).

designers, but will practicing designers judge these methods to be adequate, relative to their own unique ways of distinguishing masterful from novice or incompetent design work? When understood as a standard of methodological rigor, unique adequacy requires researchers to become so competent that fellow practitioners will take their findings as seriously “instructive in and consequential for” (Livingston, 1986, p. 6) their ongoing work.

The second ethnomethodological term that Lynch discusses is an attitude of analytical “indifference.” At first blush this may imply a detachment from the practitioner’s pragmatic concerns. It is true for example that an ethnomethodological study of surgical practice will focus on how surgical procedures are “achieved” by local teams, rather than whether their practice is optimal in safety, efficiency or fairness. At the same time, practicing indifference does not entail freeing oneself from prior theories and potential sources of bias in the empiricist sense embraced by some proponents of grounded theory (Suddaby, 2006).²⁶ Whatever critiques we might reasonably direct at ethnomethodology, we can be sure that Garfinkel’s preoccupation with Durkheim’s aphorism in *Ethnomethodology’s Program* (2002) was no exercise in forgetting social theory, that Sacks’ knowing silence was no sign of mere ignorance. As Lynch (1999, p. 221 *italics original*) put it, “indifference is not a matter of taking something away, but of not taking up a gratuitous ‘scientific’ instrument: a social science model, method, or scheme of rationality for observing, analysing, and evaluating what members already can see and describe as a matter of course.” Researchers working in this vein might benefit from reading Ontological works and they might knowingly avoid the pitfalls that Orlikowski and Scott (2008) associate with technology research streams I and II, even while viewing the adoption or advocacy of an Ontological philosophy with indifference. In this tradition the challenge of exploring sociomaterial practices might be re-specified as something that practitioners do as a matter of course in their ongoing work; the role

²⁶ On a related note, some may initially perceive this essay’s broader argument as favoring empirical or practically ‘applied’ social science in an anti-philosophical sense. As my references to philosophers such as Berlin, Wittgenstein, Hacking, Williams and Mol should convey, this would be misguided. Anti-monism is not a critique of philosophy in general, but rather a critique that some philosophers have made of some philosophies—in particular the grand and totalizing visions that dominated twentieth century philosophy.

of the ethnographer being to identify perspicuous cases and convey people's lived experience in meaningful ways.

Taken to a radical extreme, unique adequacy and an attitude of indifference could undercut every general methodological rule, analytic procedure or evaluative criterion. Taken in more modest measure, they still suggest that participant observers should actually participate (rather than merely shadowing), attain real competency in the practices they study, and write in a way that reflects their competency. That is to say, they constitute a strong version of the ethnographic program of understanding ordinary ways of life from a native point of view.

Once made explicit, it becomes clearer that this methodological indifference to grand -isms surfaces again and again among ethnographers, particularly those whose work bears the influence of ethnomethodology. Suchman (2006a, p. 325) puts it succinctly in a telling book review:

Why, rather than indexing a complex and internally variegated (even contentious) discussion, do either cyber or technofeminism become isms? What does it mean to coin an 'ism', rather than (just) to enter into a collective and multi-vocal discussion with one's own, particular line of argument?

She offers a similar perspective in the introduction to her book *Human-Machine Reconfigurations* (2006b, p. 1-2) which merits extended consideration because, again, it was the first major work to introduce the notion of sociomaterial (no hyphen) practices to an audience of technology researchers:

Casper (1994) proposes that discussions of nonhuman agency need to be reframed from categorical debates to empirical investigations of the concrete practices through which categories of human and nonhuman are mobilized and become salient within particular fields of action. And in thinking through relations of sameness and difference more broadly, Ahmed (1998) proposes a shift from a concern with these questions as something to be settled once and for all to the occasioned inquiry of "which differences matter, here?" (ibid. p. 4). In that spirit, the question for this book shifts from one of whether humans and machines are the same or different to how and when the categories of human or machine become relevant, how relations of sameness or difference between them are enacted on particular occasions, and with what discursive and material consequences.

This orientation has clear implications for the acerbic philosophical debates that we discussed earlier. This orientation does not seek to discredit works in the mould of agential realism or critical realism or mangle of practice, far from it. But it does involve

openness to a mindful, sophisticated not taking up of such grand philosophical perspectives. When a commitment to pluralism is our logical basis for allowing this re-orientation to abstract theory and re-specification of the role for empirical inquiry, we are granting what I call room for silence.

In summary, thorny Ontological debates have engendered cries for pluralism in the sociomaterial practice discourse, lest any one researcher's generalizations about materiality foreclose or discredit further inquiry. A clear alternative to the pluralism of general philosophical theories is to write about encounters with particular sociomaterial practices in concrete cases. This view of sociomaterial practices as ontological topics inevitably raises questions about whether our pluralism will be sweeping enough to grant researchers room for silence with respect to Ontological generalization. Some will no doubt expect ethnomethodologically informed studies to justify their approach more capably than I have managed here. However, I would like to suggest that by first establishing ethnomethodology's place in the turn to practice and in seminal studies of sociomaterial practices, we have reversed the onus of explanation. The question now, in light of ethnomethodology already having been included, is this: on what grounds should the research community limit itself to the pluralism of incommensurate general philosophies when a more lively form of pluralism is also available to us, and indeed mainstreamed in the practice turn generally?

This pluralism would allow for studies that ask, in what manner is the entanglement of human activity and materiality relevant in the concrete practices we observe, here? With this question of relevance to particular cases we finally return to how pluralism and practicality are related, and how both might be addressed through the orientation to theory that affords room for silence. In the final portion of this essay I offer an illustrative example of how granting room for silence with respect to Ontological debate may have the consequence of enabling researchers to re-orient their analysis to pragmatic matters of human concern. To that end we now turn to an empirical case, that of the 2013-2016 Ebola outbreak in West Africa.

2.7 The 2013-2016 Ebola Outbreak in West Africa

To suggest some themes of a way forward for the pragmatic exploration of sociomaterial practices, we now turn to the 2013-2016 Ebola outbreak. By May 2016,

the World Health Organization had reported 28,616 suspected cases and 11,310 deaths, mostly in Guinea, Liberia and Sierra Leone (WHO, 2016). While a comprehensive case analysis exceeds the scope of this essay, three themes merit our attention.

First, some well-meaning humanitarian efforts were remarkably naïve about what material goods to send and how these might be used to address the outbreak. As reported in *Fast Company* (Brownstone, 2014) and *Politico* (Allen, 2014), tech giants including Google, Amazon and Ericsson, and techie charities including the Paul G. Allen Foundation donated thousands of smartphones to the Ebola response. We might acknowledge the eminent reasonableness of players in tech focusing on what they do best. Yet there is an obvious tone-deafness in sending smartphones to health workers who were dying for lack of rubber gloves and masks that would have made patient care safer (Dahn, Mussah & Nutt, 2015). A senior innovation advisor at UNICEF went so far as to say that, “it might be better to dump the smartphones into the ocean than to dump them onto the Ebola emergency response” (Allen, 2014). The choice of smartphones, powerful computing machines that must be charged daily, betrayed ignorance of the infrastructural shortcomings (including poor access to electricity) that enabled Ebola to spread in the first place. Some would call it a failure of imagination (Farmer, 2013), in which the path of intervention reflected the well-meaning technocratic preconceptions of development experts more than pragmatic cooperation with people who were struggling, and often failing, to survive. To be sure, the Ebola outbreak was exacerbated by intense communication challenges, but these had to do with poor coordination and running out of airtime for phones people already had to hand, not a lack of computing power. Such feckless attempts at digital intervention highlight the need for social research, for design-oriented research in particular, in outbreaks.

Second, a steady stream of news reports commented on “traditional burial practices,” observing that customary ways of touching the bodies of the deceased had enabled Ebola to continue spreading. Anthropologists were called on to help healthcare organizations understand these practices. These social explanations of burial practice persisted despite widespread recognition that rubber gloves had run entirely out of stock in many places (Dahn et al., 2015). Few news agencies plumbed the moral implications of these claims—that West Africans were ignorant (rather than, say, courageous) for burying their loved ones even when they lacked the means to do so safely. Taken in

isolation, such social claims all too easily suggest that thousands of West Africans died because of their “local culture” rather than because they were poor, because local clinics and the health workforce had been decimated by decades of civil war and under-investment. Narrowly social claims can direct attention away from the widespread scientific consensus that this pathogen could never have proliferated in regions with relatively robust material infrastructure for public health. The physician-anthropologist Paul Farmer (2004, p. 216-220) has argued that such immodest claims of social causality often play out when social scientists attempt to explain infectious disease outbreaks in terms of their own niche field of expertise, without sufficient grounding in the concrete material realities of such cases. Thus we observe a tendency to tilt towards either materially deterministic presumptions or purely social explanations of disease outbreaks, much as has been observed in technology research. Clearly, there is a need to ground social analysis of the Ebola outbreak in concrete practices of care.

Farmer’s antidote to technocratic failures of imagination on the one hand and immodest claims of social causality on the other is a more integrated approach to biosocial analysis of disease outbreaks (Farmer, 2000). This approach seems highly appealing when we consider how Ebola survivors were subsequently enlisted as workers in the Ebola response. For example, when Ebola spread to the home of Liberian nursing assistant Salome Karwah (Figure 2.1), the disease killed her mother, her father, her brother, aunts, uncles, cousins and a niece. Salome, her sister and her fiancé survived. According to TIME magazine:

Karwah used to joke that survivors had “super powers” — because after overcoming the disease they were forever immune from it. Like any superhero, she often quipped, it was her moral duty to use those powers for the betterment of humankind. So as soon as she recovered, she returned to the hospital where she had been treated — the Médecins Sans Frontières (MSF) Ebola treatment unit just outside of the capital, Monrovia — to help other patients. Not only did she understand what they were going through, she was one of the rare people who could comfort the sick with hands-on touch. She could spoon-feed elderly sufferers, and rock feverish babies to sleep (Baker, 2017).

Figure 2.1: Ebola Fighter Salome Karwah as TIME Person of the Year



Salome Karwah was not alone in this work; her fellow survivors were actively recruited. Recruiting Ebola survivors to mobilize their distinctive bodily skills in a campaign to contain an infectious disease seems to suggest a remarkable form of biosocial organizing. And never does organizing seem more central to the human condition than when we see it in responses to such terrible adversity.²⁷ We would do well to investigate the material and human basis on which such practices of organization are even possible, and to avoid any facile tendency to tilt towards whatever causal explanation suits our disciplinary purview or the latest theory-governed discourse.

At first impression biosocial analysis would seem similarly helpful in explaining the Ebola-driven “outbreak of outbreaks.” Ebola so extensively disrupted routine health services, including immunization for Measles, that it has been estimated more people will die from Measles as a result of Ebola than will die from Ebola directly (Takahashi et al., 2015). This has to do with the fact that many were reasonably afraid of clinics during the outbreak and may still be avoiding them. Additionally, the higher survival rate for measles infection is offset by the fact that it is more contagious and difficult to contain than Ebola. Perhaps most importantly, clinics now are urgently understaffed

²⁷ This story may seem all the more poignant and complex in light of news that Salome Karwah recently died in childbirth, in part because fellow health workers were afraid to touch an Ebola survivor who unexpectedly began to have seizures after giving birth (Baker 2017).

because so many health workers died of Ebola. Routine health system monitoring data now show that the rate of immunization for measles has dropped precipitously, with consequences for future disease outbreaks that are relatively predictable.

It would be impossible to explain such a phenomenon without reference to both the biological basis of infectious diseases and the social conditions in which outbreaks occur. Moreover, the materiality of this case clearly extends beyond the biological. It was widely reported that a primary disruption in routine health services was the death of health workers who ran out of personal protective equipment: rubber gloves, masks etc. (Dahn et al., 2015) and were unable to coordinate with parties that might have resupplied them. Today's empty clinics cannot be explained without attention to the failings of Ebola interventions, including some feckless attempts to intervene with digital technologies. This was a high stakes case for coordinating with mobile phones and we cannot appreciate its complexity—in the manner that the design practitioner must—if we analyse digital technology as the only relevant form of materiality at play. Thus the third theme of this case is the entanglement of multiple materials in complex practice. The limitation of analysing bio-social interaction, or socio-technical interaction for that matter, is that it would support a view of interactivity and emergence that is limited by the analyst's disciplinary niche. The field of view may be broader than in tech- or bio-deterministic analysis or in pure “social” analysis, but it is still more limited than when we consider practices more holistically.

This case emphasizes the real human stakes of ontological debate. Will aid agencies allow funds earmarked for Ebola to be used in the Measles response? They may, if the “build back better” slogan that gained favour among Ebola responders (Chan, 2015) withstands academic and policy critique and remains popular in post-Ebola health systems strengthening efforts. Will future global health efforts avoid facile “social explanations” and ground digital interventions in a more holistic sense of concrete practices of care? In pragmatic terms, will we continue to dump smartphones on social problems, or might we design digital interventions in a more human-centred manner? Perhaps, if the provocative call to study sociomaterial practices finds purchase in design research and in the pragmatic work of designing human-centred systems in such complex and challenging situations.

2.8 Discussion of the Illustrative Case

To reflect on this case in light of the essay's general arguments, we might first ask whether this kind of analysis is well understood as an exploration of sociomaterial practices. Clearly I have maintained a notable degree of room for silence; anyone hoping to find Jones' (2014) five notions or any kind of -ism in this case will need to do some of their own analysis on top of what I have offered. Yet on the basis of family resemblance, we can clearly recognize that this text has more in common with other explorations of sociomaterial practices than with Orlikowski and Scott's (2008) characterizations of technology research streams I and II. The tendency to tilt towards either social or technological explanations is not presumed to be problematic in general, it is shown to be problematic in this particular case. The tech-deterministic perspective is implicit in feckless attempts at digital intervention—the tech-utopian attitude that smartphones will fix it! Purely social explanations are shown to be problematic in cases where they all too easily seem to blame people for the traumas they experience, eliding the crass materiality of poverty and the real sociomaterial complexity of the situation at hand.

Second, we might consider whether there is “anything new” here. To this point, I would submit that the notion of biosocial organizing in outbreak response merits further inquiry. It suggests that responses to disease outbreaks may be characterized by different sociomaterial practices than other forms of temporary and humanitarian organizing, such as responses to major earthquakes or civil strife. In such a brief case it is only possible to hint at the path that further inquiry may follow. I believe this is enough to clarify how writing about the production of particular concrete sociomaterial practices might yield meaningful contributions to learning, while allowing room for silence with respect to macro theories of all (socio)materiality.

For the second part of the “anything new” question, we might ask whether the exploration of sociomaterial practices illustrated here goes beyond (without necessarily discrediting) prior work in information systems, technology or design research. To this point we might acknowledge that the sociomaterial analysis enables a generative conversation with the concepts and topics of adjacent fields, including anthropology's well-established tradition of biosocial analysis. Put simply, materiality and technology are not synonyms unless the observer's field of view is very strictly limited by disciplinary

purview. The opportunity for multidisciplinary perspective was not lost on the leading lights of the sociomaterial practice discourse (Ingold, Introna, Kavanagh, Kelly, Orlikowski & Scott, 2016). It should be taken seriously when we consider whether there is “anything new” about sociomaterial practice in relation to prior work on sociotechnical systems (Porra & Hirschheim, 2007; Scacchi, 2004) or the software as tool and material approach (Ehn & Kyng 1986). To be sure, it could be said that Actor Network Theory would be just as suitable for analysing this case. While ANT is in some respects welcomed under the sociomaterial umbrella, it is presently not at all atypical for anonymous reviewers to offer criticisms such as, “I don’t see why the authors have chosen sociomateriality when it seems like a more familiar theory such as ANT would be more suitable to their case.” To such criticisms, authors seeking room for silence might follow the lines of Kunda’s (2013, p. 22) critical response:

Does it make a difference? On what basis was I able nevertheless to make my arguments? Would using Foucault [or ANT] have improved the validity of my arguments or just their perceived legitimacy? And is the ultimate purpose of writing to continually exemplify with data and demonstrate the validity of the language and claims of canonical writers?

The degree to which an analysis foregrounds the language and claims of canonical writers raises another aspect of this case, which is the extent to which students of sociomaterial practices have room to foreground the language and practical concerns of practitioners. As I polish this manuscript, technology designers are making sense of what can be done to build back better after Ebola, of what may be done to address the global Zika outbreak, of the clear and present danger that as many as 20 million human beings will die of starvation in famines spread across four regions in 2017 (Sengupta, 2017). These situations present challenges of real human concern. To document such cases as mere instances of constitutive entanglement or intra-action, with the primary aim of besting some other variant of sociomateriality, is not the same as to address these problems through searching, critical reflection on the activities, language and claims of practitioners. Extracting conceptual puzzles of relatively little social importance from within situations of great human concern will even strike some practitioners as ironic and troubling, particularly if we understand this to be a systematic tendency of a scholarly *modus operandi*. Some few shining paladins of sociomateriality might transcend the dilemma of rigor or relevance, directly addressing matters of real human concern even while fully engaging the language and claims of canonical philosophers, all

in relation to the same empirical data. However, most fieldworkers will continue to experience something of a dilemma here. A lively pluralism will encourage both tacks, granting room for silence to some studies just as others are granted relative reprieve from the difficult work of establishing clear implications for design and/or practice.

On that note let us finally consider how this line of analysis relates to implications for design practice. Our earlier discussion highlighted that Schön's view of reflective practice bears an unmistakable family resemblance with Suchman's notion of situated action. These works clearly establish the value of approaches to design that are oriented to or based on a nuanced treatment of concrete practices. Building on respective groundings in pragmatism and ethnomethodology, they emphasize how doubt, perplexity, material 'back-talk' or disruption often trigger reflection-in-action or situated problem solving. In this view, grappling with the complexity of emergent practices is something that designers inevitably do in the course of their work. Design-oriented researchers have an opportunity to participate, observe and theorize their experiences in ways that make researchers and practitioners alike more articulate, perceptive or reflective. The notion of sociomateriality suggests new ways of exploring what makes practices so complex, but it does not necessarily refigure why designers must attend to the emergent complexity of practices. In this sense it opens up new opportunities for design research, but need not be read as a rejection of designing as we know it.

The case above foregrounded the emergent sociomaterial entanglements of Ebola pathogen and human bodies, means of burying the deceased, health systems infrastructure and coordinated distribution of protective equipment, the die-off of health workers and resurgence of the measles pathogen. The popularity of the "build back better" slogan was generally used to communicate the importance of addressing all of these issues in a holistic, integrated manner. This suggests that Ebola responders were aware of these complex entanglements, making this a perspicuous case for the study of sociomaterial practices. In such cases, the exploration of sociomaterial practices might be re-specified as something that practitioners do as a matter of course. The challenge for design-oriented ethnographers then becomes to unpack what "build back better" actually means. Thick description is a distinctive way of showing how the concrete details of the situation might justify the critique of "dropping smartphones on the Ebola outbreak," or alternative proposals for designing digital interventions differently.

In more general terms, we researchers have an opportunity and perhaps a responsibility to increase design practitioners' ability to perceive, articulate and reflect on the complexity of their work. Their failures of imagination and hard won successes merit our attention. If we are to recount their lived experience with sociomaterial practices, in ways that are seriously instructive in and consequential for their ongoing efforts to address problems of real human concern, we have a great deal of work to do.

2.9 Conclusion

Ethnography is still a relatively artistic, improvised, and situated form of social research where the lasting tenets of research design, theoretical aims, canned concepts, and technical writing have yet to leave a heavy mark. In the end, this is the way I think it should be, for a persuasive and widely read ethnography will always be something of a mess, a mystery, and a miracle. John Van Maanen, Tales of the Field (2011, p.175).

William James (1907) once described pragmatism as “a new name for some old ways of thinking.” The paradox that something very old can yet be ground breaking is easily understood as a matter of *novelty in context*. Hacking (2007) makes this point succinctly: “had I begun my formal study of philosophy in the United States... I would have been educated in the shadow of logical positivism. Hence I would have discovered pragmatism as rebellious liberation.” I would say the same of room for silence, that it is a new name in a novel context for some old ways of thinking about pluralism and practicality. I am hardly the first author to voice concern over the distorting character of increasing abstraction or the dilemma of rigor or relevance; pragmatists have laboured here for well over a century. Yet by creatively re-reading the recent sociomaterial practice discourse in light of these concerns, this essay offers several contributions.

First, to construct a conceptual basis for room for silence I have modestly redrawn the map of the sociomaterial practice discourse, emphasizing a broader range of practice theories and clarifying the particular kind of pluralism that is widely embraced in social theory's turn to practice. I argue that Wittgenstein's notion of family resemblance is a more artful way of recognizing proper practice theorizing than categorical, definitional debate or lists of required conceptual elements. In particular I draw attention to ethnomethodology and to design work in the pragmatic reflective practice tradition as test cases for this pluralism. In redrawing the map in this manner, I illuminate new opportunities to investigate design work, exploring how human activity

and various materials can make a generative difference in the production of practices. I also suggest an alternative reading of the sociomaterial practice discourse that welcomes pragmatic relevance to matters of real human concern.

Second, I argued that pluralism and practicality are related, and that they might both be cultivated through an orientation to theory that I call room for silence. In this view, generating abstract “theories of everything” and elaborating or debating them in relation to empirical observations is only one way of contributing to learning. An alternative approach is to focus on fieldwork and the guiding question, how are a range of materials and human activities consequential in producing the concrete practices we observe, here? When a commitment to pluralism is our logical basis for allowing this re-orientation to theory and to ongoing exploratory fieldwork, we are not shying away from theoretical sophistication so much as we are granting room for silence. For the ethnomethodologist this is a matter of theoretical and empirical sophistication, for the pragmatist it speaks to the dilemma of rigor or relevance. Either body of concerns, and surely others as well, might lead us to embrace Nicolini’s (2012b) toolkit pluralism or heed Weick’s (1996) admonition to ‘hold our tools lightly.’

Finally, I draw on publically available information to construct a brief illustrative account of the 2013-2016 Ebola outbreak in West Africa. My analysis of the case highlights the immodest claims of social causality and technocratic failures of imagination that at times have characterized global health and humanitarian interventions. In so doing, I suggest connections between sociomaterial practice and a pragmatic tradition of caring and social reform-oriented biosocial analysis that is well established in medical anthropology. The case shows that studying the lived experience of people as they encounter sociomaterial practices is an ontological concern. Yet if our scholarly aim is to address matters of real human concern, it is not necessary or inevitable that exploring ontological topics will involve committing to Ontological philosophies or –isms of any kind.

Through these contributions, I hope to build a bridge between sociomaterial perspectives on complex practice and the pragmatic work of designing human-centred systems for the social good, for human rights and for humanitarian aid around the world. While I have offered a conceptual defence of room for silence, I am aware that many fieldworkers will appreciate this approach simply because they enjoy a more

informal relationship with theory. I feature the quote above to register my opinion that embracing room for silence with this attitude is appropriate, even if some scholars will inevitably label it ignorant or even insolent. As Van Maanen has most astutely observed, ethnography's relation to grand theory has long been troubled, not for lack of effort or intelligence among ethnographers, but because formal rules and frameworks often break down under the strain and surprising complexity of real life. Whatever our professional obligations to remain embedded in disciplinary norms and standard ways of figuring contributions to learning, design researchers who address matters of real human concern often feel a fierce sense of urgency to transcend these confines. In the conceptual scramble that often ensues, some of my fellow travellers may see the notion of room for silence as a reprieve from formalisms and orthodoxies. Perhaps this is as it should be, for a persuasive and widely read account of how technology and design can make for a better world will always be something of a mess, a mystery and a miracle.

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3 DESIGNING FOR THE EMERGENCE OF SOCIOMATERIAL PRACTICES

Insights from an ICT4D Initiative in Kenya's Immunization Program

Isaac Holeman and Michael Barrett²⁸

ICT4D initiatives hold potential to transform health service delivery in settings of poverty, yet in practice they face many of the same implementation complexities and coordination challenges as the global health and development programs that they aim to streamline or strengthen. Researchers and practitioners alike are now quick to observe that ‘context matters,’ but this does not amount to a coherent alternative vision of more appropriate ICT4D design and implementation. In this article we draw on the metaphor of imbrication to elucidate the iterative process by which ICTs become entangled with particular contexts of use. Our longitudinal ethnographic study examines

²⁸ This paper is the culmination of a highly collaborative effort spanning several years. Our analysis is based on fieldwork conducted by IH initially during MPhil studies in the Cambridge sociology department and later under MB's supervision at the Judge Business School. IH coded the data and led the writing process. Both authors remained closely involved throughout an extended, iterative process of analysis, writing and revision of the final manuscript.

the implementation and iterative redesign of an Internet of Things technology that collects real time data and alerts health workers of disruptions in the cold storage of vaccines in Kenya.

Extending recent work on imbrication, we show that technologies imbricate not only with the social context but also with local material infrastructure, and that designers play a limited yet clearly consequential role in this process. To explain these findings, we highlight instances of material “back talk” and concomitant practice breakdown, in which initial attempts to shape a situation yield puzzling or unappreciated consequences, leading designers to accommodate material realities and ultimately pursue unanticipated courses of action. Drawing on these conceptual tools, we reveal six overlapping activities through which designers may guide the emergence of sociomaterial practices. We say that they design for the emergence of sociomaterial practices to underscore that designers cannot predict or control all contextual complexities, though they can adapt to them when they arise. Based on our insights about this process we develop three contributions. First, we offer fresh perspective on the longstanding concern with local context in ICT4D research. Second, we suggest that our notion of designing for the emergence of sociomaterial practices is relevant for and adds to contextually aware design research frameworks such as Action Design Research. Finally, we propose that ICT4D practitioners should attend to practice break downs and material back talk as they grapple with the complexities of the implementation bottleneck in global health and development.

3.1 Introduction

Vaccines are among the more cost-effective health interventions ever developed and alliances of international donors supply national immunization programs in poorer countries with vaccines to cover their populations. Nonetheless, approximately 1.5 million children died of vaccine-preventable diseases in 2011 (Gates Foundation, 2014). Shortfalls in routine immunization illustrate what some have termed the implementation bottleneck: the growing global burden of illness attributed to conditions for which there are effective and affordable treatments, yet inadequacies with respect to delivering them successfully in settings of poverty. The interrelatedness of human health and development means that this implementation gap concerns not only health systems,

but sustainable development at large. Following Sahay (2016) and others we take the view that health is development, for it correlates with prosperity (World Bank, 1993) and health equity is an important aspiration in its own right (Qureshi, 2016).

Digital health and in particular mobile health (or mHealth) interventions have featured prominently in global health delivery efforts. As one World Health Organization report put it, “mHealth has the potential to transform the face of health service delivery across the globe” (Kay & Santos, 2011 p.1). Yet in practice these digital technology initiatives face much the same implementation complexities and cross-cutting coordination challenges as the global health and development programs that they aim to streamline or strengthen. The proliferation of small mHealth and information and communication technology for development (ICT4D) pilots has become so severe that many bemoan a widespread “pilotitis,” as if the failure to cultivate scalable, replicable and effective interventions in development or humanitarian contexts were a kind of disease (Shuchman, 2014; Tomlinson, Rotheram-Borus, Swartz & Tsai, 2013).

Practitioners and researchers alike now embrace the dictum “context matters!” Yet this does not amount to a coherent alternative vision of more appropriate ICT4D design and implementation. In an important step towards such a coherent alternative, the Principles for Digital Development consensus statement²⁹ urges practitioners to embrace guidelines such as “design with the user,” “employ a ‘systems’ approach to design,” “develop projects in an incremental and iterative manner,” and “work across sector silos to create coordinated and more holistic approaches.” The statement has been endorsed by many authoritative global health and development institutions, including the US Agency for International Development, The Bill and Melinda Gates Foundation and several United Nations agencies. The shift in emphasis from ICTs that support service delivery to principles for designing ICTs effectively is substantive, for it recognizes the opportunities of ICT4D without attributing impact narrowly to discrete technologies. However, there remains a widespread lack of clarity about how to put these design

²⁹ Principles for Digital Development, see <http://digitalprinciples.org>

principles into practice in global development programs characterized by emergent complexity, ambiguity, poor coordination and rapid change (Waugaman, 2016).

In this article we explore how the information systems (IS) discipline might address such design and implementation challenges in ICT4D. We draw on the metaphor of imbrication (Ciborra, 2006; Leonardi, 2011) to elucidate the iterative process by which ICTs become entangled with particular contexts of use. We find the imbrication metaphor useful because it suggests a gradual intertwining of social and material elements to produce sociomaterial practices. While technologies can travel across contexts, the notion of ICT4D interventions as sociomaterial practices (Orlikowski, 2007) implies a more holistic view, in which material objects and contextually situated human activities are both integral to the ongoing performance of ICT4D initiatives. This enables us to trace how ICT4D interventions emerge without resorting to deterministic language about the impacts of either technology or human aims. Following Leonardi's call (2013 p.71), we specifically sought to elucidate how and why imbrication occurs, how material artifacts are imbricated with particular local contexts and why sociomaterial practices emerge with a certain form and not otherwise. We were particularly interested in how a developing country context might shed light on aspects of this process that would be less apparent in the North American and European contexts of most information systems research.

To this end we undertook a longitudinal ethnographic study of an ICT4D initiative that aimed to improve immunization services in Kenya. Our paper is based on 88 days of fieldwork, audio recordings and notes from 106 interviews and over 3,200 photographs. We document the implementation and iterative redesign of TempTracker, an Internet of Things system that uses remote temperature-sensors to collect real time data and sends SMS text messages to alert health workers of disruptions in the cold storage of vaccines. The purpose of this initiative was to improve coordination of the vaccine cold chain at rural health facilities in Kenya, thereby ensuring the safety and effectiveness of temperature-sensitive vaccines.

Prior work on the process of imbrication has emphasized that technology users may perceive the materiality of ICT artifacts as either constraining or as affording new capacities for action, and accordingly choose to reshape either technology or routines (Leonardi, 2011). While a helpful starting point, this framework did not map well to

some of our fieldwork experiences or to the perspective of technology designers with whom we worked throughout this study. We found that some important turns in the design process could not easily be attributed to user perceptions of an artifact's affordances or constraints, that technologies imbricate not only with the social context but also with local material infrastructure, and that designers play a limited yet clearly consequential role in this process.

To explain these findings, we draw on the notions of material “back-talk” (Schön, 1983; Yanow & Tsoukas, 2009) and concomitant practice breakdown (Winograd & Flores 1986; Yanow & Tsoukas, 2009). In this perspective on design, initial attempts to shape a situation often yield puzzling or unappreciated consequences, leading designers to accommodate material realities and ultimately pursue unanticipated courses of action. Drawing on these conceptual tools, we reveal six overlapping activities through which designers may guide the emergence of sociomaterial practices. We say that they design for the emergence of sociomaterial practices, rather than suggesting that they design sociomaterial practices, to underscore that designers cannot predict or control all of the contextual complexities that inevitably arise when people begin using new technologies. Designers can respond to such complexities though, thereby guiding the emergence of new practices.

Based on our insights about this process, we develop three contributions. First, we offer further insight into the longstanding concern with local context in ICT4D research. We emphasize how technologies imbricate with a range of local materials and highlight how features of a social context become integral to the interventions that ICT4D practitioners document in user guides and hope to replicate to other settings. Second, we relate our findings from ICT4D design and implementation in Kenya to IS design more generally, in particular reconsidering how recent work on imbrication has treated the agency of designers. We also explore the relevance of our notion of guiding the emergence of sociomaterial practices for contextually aware approaches to design research, such as Action Design Research (Sein, Henfridsson, Purao, Rossi & Lindgren, 2011). Finally we discuss how attention to practice break downs and material back talk might equip ICT4D practitioners to grapple with the many complexities that characterize the implementation bottleneck in global health and development.

3.2 Imbrication of human and material agencies

Leonardi (2011) uses the metaphor of imbrication to describe how human and material agencies intertwine to produce sociomaterial practices. This metaphor refers to ceramic roof tiles (the imbrex and tegulae) in ancient Greece, suggesting an arrangement in which two distinct kinds of elements interlock and function interdependently as a single unit. This is not to say that the metaphor need always evoke predictable grid-like orderliness:

Far from keeping distinct these two representation domains, the human and the non-human, we are going to show the ramifications of an unfolding imbroglio (Latour, 1999) for which the word 'network' turns out to be too Cartesian and tidy. The concept of imbrication better captures the reciprocal, self reinforcing, often non-linear, impacts of one representation upon the other (Ciborra, 2006).

Following Leonardi (2011; 2012; 2013), we would suggest three noteworthy advantages of the imbrication metaphor. First, it allows us to assert that human and material agencies are both integral to the performance of sociomaterial practices and thus the shaping of ICT4D initiatives, yet acknowledge that human agency is distinct with respect to intentionality and the capacity to plan and organize around goals. In this view, materiality refers to how “physical and/or digital materials are arranged into particular forms that endure across differences in place and time” (Leonardi, 2012 p.7). While the term materiality speaks to what an ICT artifact or some other object is, the notion of material agency refers to what materiality does in a particular situation. Rather than taking certain technical capacities for granted in light of an object’s inherent materiality, a performative perspective on material agency means documenting how particular material objects actually function or perform in the here and now of some particular practice.

Second, the metaphor of imbrication draws our attention to the relative path dependency or staying power of practices. As Leonardi (2011 p.151) puts it, "because the metaphor of imbrication sensitizes us to the production of durable patterns, it reminds us that all interactions between human and material agencies produce an organizational residue." Over time this residue may fade into the background of organizational life; people may “black box” their practices in the sense that they no

longer question why ongoing routines came to intersect with technologies in particular ways.

The notion that imbrications in the here and now are inevitably shaped by prior imbrications brings us to our final point: the importance of writing about cumulative changes without resorting to deterministic language. To imbricate is a verb, and the metaphor suggests a dynamic process that unfolds with the passage of time. As the growing literature on imbrication has documented, the particular manner in which human activity and materiality imbricate at some particular point in time will inevitably be influenced by current practices, which were shaped by imbrications at prior points in time. In this way we can write about a particular point in time at which a new IT artifact is introduced in an organization, while acknowledging that workers are always already immersed in prior imbrications of social activity and materiality. With this sense of gradual accumulation, the challenge for researchers is to elucidate why the process of imbrication unfolds as it does and not otherwise. That is to say, “an imbrication perspective must provide a language to explain how activities in the past condition, (as opposed to cause) future human–material sequencing” (Leonardi, 2011 p.152). To address this challenge in reference to our empirical case, we will now review related work on technology affordances and constraints, practice break down and material back talk.

3.3 Material back talk and practice break down as catalysts for imbrication

Markus and Silver define affordances as “the possibilities for goal-oriented action afforded to specific user groups by technical objects” (2008 p.622). Leonardi (2011) builds on this relational definition of affordance to examine how perceptions of affordance and constraint may catalyze the process of imbrication. This perspective places materiality analytically front and center, recognizing that the materiality of an artifact does bound the range of viable perceptions. As Pentland and Feldman (2008 p.243) remark, we cannot turn a toaster into a cellphone simply by believing it to be so. Yet this perspective also leaves technology users in the proverbial driver’s seat, insofar as their perceptions of affordance and constraint lead them to make choices about how they will imbricate human and material agencies.

While a helpful starting point, this framework did not wholly explain some of our fieldwork experiences or the perspective of technology designers with whom we worked throughout this study. When we followed TempTracker devices from a lab in California, where they had performed well, to a health system in rural Kenya, we encountered various kinds of difficulties that could not be easily categorized as perceptions of either affordance or constraint. Iterative improvements to devices were made not only to accommodate the perceptions of technology users, but also to accommodate the objective conditions in which the process of imbrication was unfolding. In later work exploring critical realism as a philosophical foundation for the study of sociomaterial practices, Leonardi (2013) argues that emphasizing people's socially constructed conceptions is entirely compatible with granting some objective reality to 'the world out there.' This involves integrating an empirical constructivism with an ontological realism:

The empirical necessarily exists always in the form of human pictures and conceptions of it. However, this does not shift "reality," as so many conclude, from the empirical world to the realm of imagery and conception... [This] position is untenable because the empirical world can "talk back" to our pictures of it or assertions about it — talk back in the sense of challenging and resisting, or not bending to, our images or conceptions of it (Blumer, 1969 p. 22, quoted in Leonardi 2013 p.68).

In this vein, our analysis draws on Schön's work on reflective practice and design as a conversation with materials (1983, p.76), which Bannon and Ehn (2013) note is a mainstay of many design frameworks. This work is heavily influenced by the pragmatist philosophy of John Dewey (1925; 2005), for whom framing situations, experimenting and learning-by-doing are central. In this view, design work is so complex that implementing a prototype or attempting to shape a situation typically yields intended and unintended consequences. The designer makes an initial 'move' and the situation often 'talks back' in the form of puzzling or unappreciated consequences. If the designer allows herself to perceive this back talk, she may respond with an alternative move, an emergent course of action.

In this sense feedback offered by a cognitively reflecting human speaker is quite different from material back talk,³⁰ which emerges spontaneously where human actors (e.g. technology end users) and non-human actors (e.g. prototypes, infrastructure, a particular office space) come into relation with unforeseen consequences (Yanow & Tsoukas, 2009). The understanding that material back talk emerges from beyond the realm of human agency is vital for the perspective that designing in this manner involves something more than implementing subjective tastes or preferences. To call it a conversation with materials suggests an active and probing kind of situated inquiry. Insofar as it addresses instances of back talk that were real and consequential, it may exhibit a kind of rigor in dealing with highly situated or contextual complexities. Such a view of rigor is important, Schön argues, if we are to transcend the dilemmas of rigor or relevance that so often play out in situations of great complexity, uncertainty, instability, uniqueness or conflicting priorities (Schön, 1983 p.42).

Winograd and Flores (1986) highlight how technology design may advance through responses to “practice breakdowns,” and while their work bears some similarities to Schön’s discussion of back talk, two differences are salient to our analysis. First, Winograd and Flores draw on Heideggerian phenomenology (Heidegger, 1996) to explain the routinized and unreflective nature of ordinary practices (a state which they call absorbed coping) and the phenomenal experience of surprise, puzzlement and reflection that practice break down may engender. Second, they incorporate a language as action perspective, treating “language as the primary dimension of human cooperative activity” (Winograd, 1986 p.203). While the former point is well suited to our analysis, the latter point is less well suited to recognizing materiality and the processes of imbrication through which human and material agencies intertwine.

To draw on Winograd and Flores’ (1986) insightful analysis of practice break down, while retaining Schön’s perspective on the significance of material back talk, it is helpful

³⁰ A genealogy of the notion of back talk is beyond the scope of this article, but it bears mentioning that the similarities between Blumer’s and Schön’s uses of the term are not coincidental. The connection is that Blumer’s symbolic interactionism and Schön’s reflective practice both bear the influence of the classical pragmatist philosophers, for whom experiences of trouble, disruption or back talk were vital catalysts and pre-conditions for directed problem-solving and ultimately intelligence and creativity.

to consider Yanow and Tsoukas' (2009) recent phenomenological re-reading of Schön's work. In their analysis, practice break down is not only a matter of social or human relations; it can also stem from concrete encounters with material back talk. Recasting Schön's work in Heideggerian terms (Dreyfus, 1991; Heidegger, 1996), they emphasize material back talk while further delineating degrees of practice break down. This framework is helpful because it emphasizes that encounters with back talk may engender a range of experiences that disrupt our ordinary unreflective coping. Before total disruption, back talk may engender experiences of annoyance, doubt or discomfort, spontaneous workarounds or even reflective planning with respect to how technologies may be used differently. When technology users experience more mild and temporary breakdowns, technology designers do not always take notice, particularly in ICT4D initiatives in which designers are often far removed from users. Even when more subtle forms of break down are noticed, they will not always be interpreted as generative opportunities for iteration, for the proactive reconfiguration of technologies or routines. Rather, this is a matter of judgment in which designers exercise considerable agency, as our findings below will illustrate.

3.4 Research Site and Methods

This study draws on participant observation and interviews conducted by the first author during three rounds of fieldwork in Kenya's rural Mavueni district,³¹ lasting a combined 88 days, from early 2013 to late 2014. This included roughly six weeks of fieldwork in March-May 2013 during an initial eight facility pilot, three weeks of fieldwork in April 2014 as nurses at more than forty facilities were being trained to use the device, and a final four weeks of fieldwork in November-December 2014 as the initiative was concluding. In addition to extensive observational and reflective field notes, the data include over 3,200 photographs and videos, audio recordings and notes from 106 interviews, 74 project documents, 658 email exchanges and meetings conducted via Skype. Before undertaking the fieldwork for this study, the first author

³¹ I have disguised the names of informants, local places (e.g. Mavueni) and organizations other than Medic Mobile, Nexleaf and Ministry of Health. In these cases I conferred with informants and we mutually agreed to publish them transparently.

had visited Mavueni on four prior occasions and had resided in the region from mid 2009 until mid 2012, during which time designing and implementing global health technologies was central to his work. Prior familiarity with the region, the Mavueni District Ministry of Health and with Medic Mobile facilitated impeccable access. Data were analyzed with an insider-outsider, iterative process of grounded coding, visual mapping and comparison with existing frameworks.

3.4.1 Case Selection

Our approach to case selection was influenced by Walsham's (2012) advice that research may be more interesting and even inspiring if we study how practitioners are using ICTs to make a better world, and also to critically analyze who benefits and who misses out. Routine immunization programs present deeply important opportunities for studying the global health implementation bottleneck and the complexities of using ICTs to address this bottleneck. Moreover, Kenya is a highly suitable setting for studying such challenges. In rural Kenya, it cannot be taken for granted that trained staff will be present during a health clinic's "open" hours, that maintenance workers will not be called on to act as nurses or vice versa, or that medical equipment, telephones, electricity, plumbing, vehicles and roads will function reliably. Public sector health workers rely on support from myriad (typically transient) international development funders and practitioners, which can further disrupt common understandings of task priority and feasibility, make work schedules less predictable, and complicate efforts to clarify who will account for particular tasks. Too often, short pilots and standalone projects are organized in disease-centric silos, further fragmenting service delivery.

We selected to study the TempTracker initiative in part because it was funded by the Bill and Melinda Gates Foundation's much-discussed grand challenges funding scheme, through a grant to the non-profit organization Nexleaf Analytics. Nexleaf had made plans to partner with Medic Mobile and we first heard about the initiative through the first author's contacts at Medic Mobile. While we were interested in participating in the design process, we opted for participant-observation rather than an overarching design research framework such as Action Design Research (Sein et al., 2011) in part because we were not in a position to establish the terms or timelines of the design process. However, the first author's prior familiarity with local culture and

language, contacts at Medic Mobile and at the Mavueni Ministry of Health facilitated unusually strong access. This enabled us to build a richly detailed case in a relatively challenging research environment in a nonetheless realistic manner (Miles & Huberman, 1994).

Finally, as Barrett, Davidson, Prabhu and Vargo (2015) observe, settings such as Kenya afford IS researchers many opportunities to extend existing theories, because such settings have such different economic and institutional structures. This is not to suggest that findings from low-income settings are so different as to be irrelevant to wealthier settings. Rather, they can be understood as what Pettigrew (1990) calls extreme cases, in that they throw into sharp relief dynamics that may be less readily observable but also at play in other situations.

3.4.2 Empirical context: Conferring immunity, delivering potent vaccines

Vaccination programs confer immunity by exposing human immune systems to pathogenic organisms (e.g. viruses) that have been modified so that they do not cause harm. Immune systems learn to recognize the harmless pathogens, and as a result they can more effectively recognize and combat future infections of the wild pathogen. An important ramification of using biological materials to confer immunity is that they rot when left at room temperature and decompose even faster when frozen, losing their structure and thus their potency. Despite extensive research and development efforts, temperature insensitive vaccines remain elusive and the necessity of cold storage at 2-8° Celsius continues to shape the work of conferring immunity worldwide.

Immunization programs accommodate the 2-8° temperature range through a variety of cold storage practices often referred to as the cold chain. At rural clinics in Mavueni, the cold chain consists of equipment such as refrigerators and thermometers, as well as infrastructure such as grid electricity, solar panels and propane to power fridges in lieu of grid electricity (see appendix Figures 3.1-3.2). It also consists of stock ledgers, paper charts and other information tools with which workers and their supervisors track cold chain equipment and activities. Nurses are expected to visually check thermometers twice daily, and to record temperatures on paper temperature charts. In practice, overworked nurses often delegate the task to data clerks, security guards and other casual laborers with little or no formal medical training. Sometimes

the task is not performed at all, particularly at the numerous facilities with just one or two nurses, as evidenced by blank fields on temperature charts observed during visits to clinics (see appendix Figures 3.3-3.4).

Managers are quick to remark that nurses face extenuating circumstances. Not only is the cold chain just one aspect of immunization; immunization in general is often sidelined as patients arrive with more urgent concerns such as broken bones, acute infections or to give birth (see appendix Figure 3.5). However understandable these deviations from the protocol may be, there is concern that the gap between official tasks and daily cold chain activities is to blame for recurring outbreaks of vaccine-preventable diseases such as measles and meningitis. As one manager put it:

When we get an outbreak, then we are looking in the program, was it the coverage? Is it people migrating to our region who were not vaccinated? Is it that the program at a time, there was a break down in that people received impotent vaccines? We all look at that, so that at any given time you want to see exactly, what was the gap?

3.4.3 The TempTracker Initiative

From late 2012 to late 2014, the Mavueni Ministry of Health worked with two international charities, Medic Mobile and Nexleaf, to pilot a remote temperature-sensing device called TempTracker for monitoring refrigerators that store vaccines at rural health facilities. Nexleaf is located in California and their primary expertise is in developing remote sensing technologies for a variety of applications in global health and international development. Medic Mobile designs and implements open source technologies for global health, and has worked in more than 20 countries from offices in Nairobi, Kathmandu and San Francisco. Both organizations are relatively small, with fewer than a dozen (Nexleaf) and approximately 60 (Medic Mobile) staff. The grant had been awarded to Nexleaf and their responsibilities in this project were product development oriented, including developing a functional prototype temperature sensor, ‘bench-top validating’ the prototype in California, and implementing iterative improvements based on field-testing abroad. Medic Mobile’s responsibilities were design oriented, including selecting a pilot location, training health workers and making recommendations to iteratively redesign the prototypes based on ongoing observation of TempTracker use and the broader work context.

TempTracker was designed to automatically measure and submit temperature data via mobile Internet, and also to send text message alerts whenever fridges reach temperatures that could damage vaccines. The initial prototype consisted of a cord four-foot in length with a temperature sensor on one end and on the other end a typical audio jack that plugs into the headphone socket of an Android smartphone. The smartphone sat inside a generic box of hard plastic, from which ran another cord connecting the smartphone to a typical electrical socket (see appendix Figures 3.6-3.7). Installed on the Android phone's operating system was a custom TempTracker "app" for syncing temperature data to a web server via mobile Internet and sending SMS text message alerts via the mobile phone network. Broadly speaking, the purpose of the TempTracker program was to improve coordination in the vaccine supply chain, thereby maintaining vaccine potency and improving population health. In particular, the primary aim was to provide health facility staff and 'frontline managers' with real time data and monthly aggregate reports, so that they could mount more timely and effective responses to cold chain disruptions.

A pilot at eight clinics began with the aim of iteratively redesigning the prototype devices, while also refining training, maintenance and other related activities, to improve and ultimately validate the approach "in the field." The Mavueni district in rural Kenya was selected as a pilot location in part because Medic Mobile had a prior working relationship with the Ministry of Health, and in part because the difficulties of providing health care in Mavueni are similar to those faced in many rural settings of poverty. While most of the clinics in the district are fully owned and operated by the ministry of health, about one in four facilities are privately owned and operated by individuals, churches or international charities. These private organizations are provided with vaccines and in most cases with fridges free of charge by the ministry of health. In turn their immunization activities are subject to standard ministry of health reporting and supervision. Some clinics are just kilometers away from the district office, while others take hours to reach over rutted dirt roads that often become impassable during the rainy season (see appendix Figure 3.8). Efforts to maintain the vaccine cold chain are complicated by electricity outages, staffing shortages, and sporadic lack of funds to fuel the vehicles that would transport district staff to rural facilities for routine supervision or equipment maintenance and replacement.

During the course of this study, health services in the region were disrupted by stock outs of vaccines and essential medicines, and health worker strikes related to delays in promised raises and disbursements of salaries and general operating budgets for clinics. Some of these disruptions were related to the broader sociopolitical context, including ongoing terrorist attacks (Bremmer, 2015), the threat of post-election violence in 2013 (BBC, 2013), and devolution of health sector governance from national to county-level, the result of constitutional amendments that followed post-election violence in 2007 (BBC, 2012). All international workers (including the first author) experienced gastrointestinal ailments, one was hospitalized for severe dehydration secondary to food poisoning, and one of the Kenyan TempTracker users died of tuberculosis. These challenges were more destabilizing than those facing most innovation teams in wealthier countries. And yet, this is precisely the kind of setting in which advocates of global health equity argue that technology and innovation stand to be of the greatest benefit to humanity.

3.4.4 Data Collection

Data collection followed common recommendations for ethnographic research (Spradley, 1980; Van Maanen, 1979; Van Maanen, 1988), involving participant observation and informal conversations, complemented by document analysis, formal interviews and focus groups. True to the ethnographic tradition, the first author was fully immersed during fieldwork, including sharing accommodations and most meals with other members of the TempTracker team. He joined the project team in visiting rural clinics, training health workers to use TempTracker, returning to clinics to provide technical support and investigate devices that were not uploading data to the online dashboard, discussing ongoing design issues with engineers in California, and reviewing the project with managers at the Ministry of Health. These activities were extensively photographed (of over 3,200 photographs, about 800 are of temperature charts and other cold chain reports). Assisting with various tasks enabled the researcher to build rapport and gain invitations to significant conversations and journeys to remote clinics that would have been far less accessible to anyone perceived as an outsider. Additionally, as Walsham, Robey and Sahay (2007 p.324) argue, researcher participation in projects of technology development and use is “particularly relevant in contexts where resources are scarce, when it can be argued that outside researchers

should not only go away with data for their academic papers, but should also aim to make a contribution in the research setting itself.”

The bulk of fieldwork, including hundreds of informal conversations, involved the Medic Mobile and Nexleaf project managers with primary responsibility for TempTracker implementation (N=3). Additional key informants included the ministry of health nurses who attended trainings and implemented TempTracker devices (32), many of whom were interviewed more than once. Managers interviewed were responsible for immunization or maintenance within the Mavueni District Ministry of Health (N=4), Medic Mobile’s Regional Director, Regional Designer and CEO and Nexleaf’s CTO and CEO. After half a dozen initial in-depth formal interviews to orient to the case, the remaining audio-recorded interviews (44 total) were interspersed with clinic visits. Later interviews typically revolved around topics that arose during clinic visits, often involving discussion of photographs taken by the researcher, following Harper’s (2002) description of photo elicitation. For example taking pictures of partially completed paper reports (see appendix Figure 3.4) and showing them to nurses facilitated conversation about how much of the cold chain was currently invisible to managers. Photos of first and second generation devices (see appendix Figures 3.6-3.7) prompted reflection on the growing ‘kit’ of ancillary user resources, and how the new resources reflected awareness of the growing number of tasks that TempTracker users were asked to perform.

As most practitioners struggle to articulate the specifics of their work outside of the context of actually doing it (Barley & Kunda, 2001; Schön, 1983; Suchman, 2006), informal interviews were often interspersed with tasks such as preparing for a training or trouble shooting a device that was not functioning properly. Cursory notes of informal interviews (62 total) were written during or immediately after these conversations, with descriptive and reflexive elaboration recorded within 24 hours. Additional field notes documented events (e.g. a distinctive malfunction observed at a particular clinic) and practices (e.g. switching out components such as batteries or sensors to isolate a malfunctioning element). The ethnographer’s privileged access also resulted in being cc’d on 658 emails which contained 74 key project documents, including work plans and presentations for the Ministry of Health that we quote in the findings below.

Table 3.1: Chapter Three Data Sources and Uses

Type of Data	Use in the Analysis
Field notes: Detailed written records of events (e.g. a clinic visit, or a distinctive device malfunction at a particular clinic), practices (e.g. systematically switching out device components such as batteries, SIM cards or sensors to isolate a malfunctioning element), and mundane activities. Supplemented by extensive notes on the ethnographer's reflections and feelings throughout 88 days of fieldwork.	Coded to trace emergent themes and referenced while writing thick descriptions of notable events and practices.
Photographs and videos: Over 3,200 photographs and videos documenting events that often unfolded too quickly to take notes in real time. Notable photos were captioned and discussed in field notes before retiring each evening.	Capturing key phenomena in rich detail, facilitating writing thick descriptions, and conveying a sense of the field to the second author and readers (see appendix). Photographs were also shown to informants to evoke responses during interviews.
Informal interviews: With nurses and all TempTracker team members in Kenya (62 interviews in total), to discuss observations and issues that emerged in participant observation or interviews with other informants. Informal interviews were occasionally unplanned, as compelling conversations emerged out of ordinary socializing. cursory notes were recorded during or immediately after interview, with more detailed elaboration within 24 hours.	Integrating observations with informants' accounts, seeking to confirm or disconfirm emergent insights through constant comparison, coded to trace emergent themes and referenced while writing thick descriptions of notable events and practices.
Formal interviews: Audio-recorded interviews with individuals or small groups of nurses, managers and TempTracker team members.	In-depth interviews helped orient the ethnographer to the case, establish the project's timeline. Later interviews revolved around integrating observations with informant accounts, for example interviewing the Ministry of Health director of maintenance for context on the feasibility/difficulty of the new tech support role that the TempTracker team hoped to establish.
Project-related documents: 658 emails discussing project updates and work plans, spreadsheets with logs of clinic visits and TempTracker malfunctions, training support material, proposals, presentations for Ministry of Health, project funders.	Triangulating with cc'd emails and attached reports/presentations was vital for discovering how the 'official line' distinguishing human error from device breakage differed from our observations 'behind the scenes' about their entanglement (e.g. talk during team meetings of the devices becoming "expensive blocks of plastic" without tech support).

3.4.5 Data Analysis

Our analysis began by documenting instances of back talk (Schön, 1983; Yanow & Tsoukas, 2009), with particular attention to difficulties in Kenya that related to the materiality of the prototype and that had not been observed during lab testing in California. During the first 6-week stint of fieldwork, it was immediately obvious that some instances of back talk were attributed not exclusively to the TempTracker device itself or to user perceptions and actions, but to differences in material infrastructure between California and Kenya. In the initial open coding that followed this round of fieldwork, we also noticed codes related to “back talk” co-located with codes related to new forms of “visibility,” “monitoring,” and related concerns of “accountability.” For example, multiple nurses reported that their device was sending faulty SMS alerts and explained that this concerned them because their managers might receive the faulty alerts and perceive them to be lazy or underperforming workers.

In comparing our codes to existing research, we began to consider this working out of supervisor scrutiny and accountability concerns as a process of emergence and to reflect on whether or in what sense design work might shape emergent practices. Particular roles, routines and new coordinating practices (e.g. phone calls to “shout for help” in cases of fridge failure) then became more explicit topics of observation, interviews and coding during the second and third rounds of fieldwork. As in other cases of longitudinal ICT4D research, spacing stints of fieldwork across a period of several years enabled us to develop a more holistic picture of how the initiative unfolded (Latifov & Sahay, 2013; Luís Mosse & Byrne, 2005).

During the third round of fieldwork, the TempTracker program had been implemented in all of the health facilities in an entire district, and the design team was increasingly concerned with documenting bugs and non-functional devices so as to inform long-term maintenance. In an attempt to reconcile all of our codes pertaining to distinct kinds of malfunction (e.g. #databacklogerror), we realized that some instances had surfaced repeatedly with ambiguous origins, or were diagnosed inaccurately, before we identified the actual cause. Eventually, this insight led to our interest in practice break downs and the idea that experiences of break down may precede awareness of material back talk as the source of a malfunction or difficulty.

The second author, who did not take part in fieldwork, acted as an “outsider” in dissecting and challenging emerging codes for these data (Evered & Louis, 1981). As Walsham (2006) observes, advantages of the ‘insider’ or involved perspective of ethnographers and action researchers include excellent access to people, issues and data. However, involved researchers may become socialized to the views of people in the field and lose critical distance. By bridging an ethnographic fieldworker’s (first author) experiential involvement and intent to understand the situation from a practitioner’s point of view, with a more detached researcher (second author) who interpreted data in light of established analytic categories, we hoped to uncover empirically grounded, yet generalizable knowledge.

To lift our initial case analysis to a more conceptual level, we used Langley’s (1999) widely cited guidance for theorizing process-oriented data through narrative analysis and visual mapping strategies. This entailed first drawing on all of the data sources described above to write “thick descriptions” (Geertz, 1973) of episodes in which back talk seemed consequential for the emergence of new practices, aiming as much as possible to convey the richness and detail of our data. For the sake of brevity we selected just three vignettes that our informants regarded as highly consequential for the overall success of the TempTracker initiative and that clearly illustrate the significance of materiality, human agency and emergence in the unfolding design process. That is to say they present the breadth and depth of relevant data and speak to the point and purpose of ethnography: “to render the actual—and to do so persuasively” (Van Maanen, 2010). Similar narrative approaches have been adopted by a number of practice based studies in IS and organization studies (Mazmanian, 2013; Oborn, Barrett & Davidson, 2011; Smets, Jarzabkowski, Burke & Spee, 2015).

We then constructed graphical representations of these episodes to serve as “an intermediary step between the raw data and a more abstract conceptualization” (Langley, 1999 p.702). Comparing graphical representations of each of our narratives helped us to identify commonalities in how these episodes unfolded, as well as patterns of difference. This resulted in the three rows (one for each episode) and six columns of data that we organize in Table II. Upon extended reflection, we began to consider the activities that reoccurred in each narrative in more general terms, as conceptual building blocks that could be used to understand other cases of designing for the

emergence of sociomaterial practices. This highly iterative process entailed cyclic reading and rereading of our data, the literature, reflection on our emerging theoretical arguments and responding to the perspectives of a highly engaged editorial team.

As Langley (1999 p.691) astutely observes, “no analysis strategy will produce theory without an uncodifiable creative leap, however small.” For ethnography in particular, it has long been recognized that moving from thick descriptions to perception of more general patterns, and ultimately an account that is more analytical and integrated with current research, is often less structured than might be expected of interview-based approaches to qualitative research (Pratt 2000; Van Maanen 1979). An obvious limitation of this approach is that it results in analyses that are inherently exploratory, rather than the one inevitable or authoritative interpretation of a particular case. In this spirit, we offer in the narratives that follow a close up and in-the-thick-of-action exploration of the process of imbrication in an ICT4D initiative.

3.5 Findings

3.5.1 Local Infrastructure and Material Back Talk in the Process of Imbrication

In the fall of 2012, implementing staff at Medic Mobile and Nexleaf delivered the devices to each of the eight clinics participating in the initial pilot, and briefly discussed the purpose of the device and SMS messages with the nurses in charge at these facilities. They then configured the devices to send SMS messages to the facility-owned phone that is normally held by the nurse in charge. The TempTracker software application can send temperature alerts via SMS text messages to any phone, once that phone number has been registered or subscribed. In most facilities, just one or two nurses were subscribed to receive updates. Routine temperature readings would be sent at 8 a.m. and 4 p.m. daily, and an SMS alert would be sent anytime, day or night, that the fridge was outside of the 2-8° range for over ten minutes.

The TempTracker web dashboard indicated that soon after installation of 8 TempTracker devices for the initial pilot, the devices began uploading temperature data as expected. However, nurses' comments concerning the accuracy of SMS notifications varied from clinic to clinic. When asked whether the SMS were accurate and how they knew, some stated unequivocally that the device sent accurate, helpful temperature

information to their phones. Many nurses mentioned verifying the temperature readings in routine SMS notifications by comparison with visual inspection of traditional thermometers. This seems to have been particularly common at smaller facilities, where the nurse in charge who holds the facility phone would often manually chart the fridge temperatures personally (rather than delegating to another worker). In other cases, nurses told stories of responding to emergency alerts and finding that their fridge was indeed outside of the acceptable temperature range:

Nurse: There was one time the power was out at midnight Sunday, and we didn't have any clients [arrive in need of emergency care] all night. And normally it's a Sunday morning and you want to sleep and you think the lights are on. But we received this message and you wake up very active, very fast indeed.

Researcher: And it was right, the message was right?

Nurse: Yes! The power was out and we switched over to propane.

A more dramatic learning event occurred several weeks into the pilot at a time when nurses in the region were on strike, demanding what would be their first salary increase in several years. The power went out at the facility and, although the nurses were not there to notice it, the nurse in charge had taken the facility phone home with her and she received an alert. Torn between breaking the strike and letting an entire fridge spoil, she called someone in the district capital, requesting that they come switch the fridge to propane back up. Some of the vials did spoil on this occasion, but the event underscored the utility of the TempTracker device and staff at this facility became enthusiastic supporters of the program.

In contrast, other facilities reported ongoing problems with the devices:

Nurse: okay, in my facility it used to give us alerts but when you just check, like at six A.M. DEET DEET (a beeping noise mimicking the tone of a phone receiving a message), “temperature dangerously low.” You check, you find it okay. Again at eight DEET DEET, “temperature dangerously low.” You check, you find it okay.

Researcher: So it was faulty?

Nurse: Yeah maybe there would be something faulty. In our case it was “dangerously low, dangerously low” and our thermometers were not off.

After the interview I [the researcher] walked around the facility and saw that the temperature sensor was sitting in a puddle of water at the bottom of the fridge. I also noticed that the sensor was wrapped in a 2 cm cube of foam. When I pointed this out to the Medic Mobile implementer who was present, he pulled off the foam to squeeze the water out, and then explained to the nurse, not for the first time he would later remark, that the sensor needed to be placed in a tray just like the other thermometers. He later mentioned that the engineer from Nexleaf (who had left Kenya before I arrived for fieldwork) had added the foam cubes to all eight devices a few weeks into the pilot in an effort to address initial complaints of inaccurately low temperature readings. The hypothesis was that the sensor may have been brushing up against a piece of ice or cold metal, but adding foam cubes did not seem to solve the problem.

Back at a university lab in the United States, the Nexleaf engineers dug deeper into the temperature data via the online dashboard. Eventually they noticed occasional changes of 2-6° far faster than the actual temperature could be changing. Such fluctuations did not occur with devices in the lab, so they reasoned that the errors must have something to do with the local context in Kenya. Eventually one of them hypothesized that the fluctuation in temperatures was due to electrical “noise,” stray electrical signal getting picked up by the phone’s audio jack, augmenting the amplitude of the electrical signal that was feeding from the temperature sensor into the audio jack. According to a Nexleaf engineer, that amount of electrical noise is atypical in North America, but their lab was eventually able to replicate some of the temperature reading noise by surrounding a TempTracker device with halogen lights and a wall heater. Having identified noisy electrical signal as the culprit, they then developed a software algorithm to filter the temperature readings. Thinking that temperature data would be the only electrical signal feeding into the phone’s audio jack, they had initially programmed TempTracker to capture signal amplitude at any frequency. However, they knew that the frequency of the temperature signal was 435 Hertz, and by switching from sampling all frequencies at given points in time to sampling only at the specific frequency of 435 Hertz, they were able to filter out the noise at different frequencies (see appendix Figure 3.9). As a result, their temperature readings became more precise once this software filtering algorithm was implemented.

In this case, TempTracker's performance in Kenya fell short of its performance in California because of how it related to local infrastructure. TempTracker engineers had not anticipated these particular infrastructure difficulties, though prototyping locally was predicated on the view that it would lead to insights that would not or could not have emerged in a laboratory. By enacting forms of back talk that would never have arisen during testing in California, and by making the prototype devices more robust in response, the design team validated their decision to prototype locally. Thus rather than regarding this episode as a temporary failure of TempTracker devices, it might be understood as an early success in designing through local conversations with materials. This is just one of more than half a dozen cases in which TempTracker devices were modified before the end of the initial pilot at 8 facilities. While some of these iterations seemed relatively minor, implementers and health workers clearly deemed them serious enough that they would not expand the small eight-clinic pilot to more facilities until they had been addressed.

3.5.2 Biological Materials, Back Talk in the Emergence of New Features and New Routines

In other cases, TempTracker was redesigned to accommodate local cold chain coordination routines. Nexleaf engineers initially had imagined that clinic-based nurses would act on real-time text message alerts and automated data collection would come to replace district-level managers' use of paper-based monthly temperature charts. However, they soon found that managers generally rely more on phone calls from nurses than on monthly reports for monitoring cold chain performance:

They [clinic-based nurses] are supposed to submit to us the cold chain recording sheet. If at a particular time the temperatures went up, they went high beyond the required limits, we normally call them to ask what happened and you never reported?

The potential for an accusation that the facility "never reported" is telling, given that the supervisor was describing how she would respond to discovering a temperature spike by scrutinizing the most relevant paper-based report. While this initially surprised the technology designers, managers explained that they expect to hear about such important events long before receiving monthly reports, in part because vaccines degrade rapidly. News of a cold chain malfunction hurls workers into a trouble-shooting pipeline in which they have perhaps half a dozen hours to fix equipment or relocate

vaccines. The temporal urgency of vaccine degradation underlies a mutual understanding among nurses and their managers that, while monthly reports are a bureaucratic necessity, timely “shouts for help” are vital for coordinating responses to cold chain disruptions.

Most nurses expressed appreciation for SMS temperature alerts for enabling them to coordinate responses to cold chain disruptions even when they were away from the clinic. As one nurse enthusiastically explained, “when I got this [TempTracker device], then I don’t have to go there [to the clinic] over the weekend because I just got the SMSs through my phone. Amen.” The alerts spurred responses to cold chain disruption much as a phone call “shout for help” from another worker would have. After discussing these alerts with nurses and implementers, managers also expressed interest in receiving real-time alerts, rather than focusing solely on monthly reports. A negotiation then unfolded among managers who wanted real time information and nurses who wanted time to act before facing the scrutiny of their supervisors. Eventually all parties agreed to a new feature: sending “escalated alerts” to managers six hours after nurses received word of a high temperature or half an hour after receiving word of a low temperature. These time buffers reflect a delicate compromise with consideration for the duration and improvisational nature of coordinated responses to cold chain disruptions, the relational priorities of managers and nurses, and their interpretations of biomedical knowledge concerning immunization. It is in this sense that the link between population immunity and the biological process of vaccine degradation is mediated by cold chain coordination activities. This is important because it again draws our attention beyond the prototype itself to the ways that TempTracker relates to the diverse material and human actors of particular situations.

3.5.3 Categorizing Break Downs, Guiding the Emergence of a New Role

In less than two years, the initial eight-facility pilot expanded to district-wide use at more than forty clinics. While coordinated responses to cold chain disruptions typically reflected the temporal pace of vaccine degradation, another timeline had begun to pressure Nexleaf, Medic Mobile and the Ministry of Health to consider the sustainability of their inter-organizational partnership. Like many global health initiatives, the TempTracker program was funded by a specific grant and governed by a

time-delimited memorandum of understanding, signed by representatives of all three organizations. While Nexleaf and Medic Mobile initially provided the bulk of support and follow up to ensure devices were functioning, in the final months of the initial memorandum there was growing concern that the ministry be fully prepared to provide on-site maintenance and support in the long-term.

This entailed identifying which ministry staff person(s) across various departments (local nurses, immunization, monitoring and evaluation and maintenance staff at the district office, and Nexleaf engineers in California) had appropriate skills and availability for particular TempTracker maintenance tasks. It subsequently involved training these people and creating new role-specific guides and reference materials. It also entailed negotiating with higher-level managers to ensure that they officially approved of these arrangements and allocated budget appropriately, with the understanding that all Ministry of Health staff have many other priorities and international aid projects to contend with.

While there was a clear sense that only the ministry could sustain local support tasks long-term, it was also clear that Nexleaf would need to play some role in troubleshooting, repairing or replaces devices with more complex or atypical problems. At this stage in the design process, categorizing ordinary disruptions (to be dealt with locally) and ‘beyond ordinary’ malfunctions was a non-trivial challenge. Moreover, it was also clear among Nexleaf and Medic Mobile staff that they needed to help construct a reasonable value-proposition for the cash-strapped ministry to take accountability for these tasks, or else accept that the project would not be sustained. As one implementer remarked during a teleconference, without tech support capacity at the ministry, TempTracker devices would “shut down one by one on their own. At that point we have to acknowledge that the program won't be sustained and we're actually funding heavy blocks of plastic.”

As these inter-departmental and inter-organizational coordinating activities proceeded, Nexleaf and Medic Mobile staff continued implementation and design activities. This was a priority in part because determining which people had appropriate skills to account for particular tasks entailed reassessing how robustly the devices were performing at that point in time. A number of known problems had been addressed and many devices were uploading data and sending alerts daily, yet others were not

functioning and from the district office (let alone abroad) it was often unclear why. Upon visiting clinics where TempTracker was not functioning we found that in some cases devices had simply been left unplugged or nurses had not added airtime as planned, but other cases reflected a more complex process of disruption. Eventually it became clear that devices at a handful of clinics had taken temperature readings every ten seconds for weeks or months, but had not uploaded any data. At most of these clinics, financially constrained nurses had for some time not replenished airtime for connecting to the mobile phone network. In at least two clinics mobile internet connectivity had simply been atypically poor for several months. Eventually larger amounts of temperature data accumulated on the devices than had ever been tested in the lab, causing the TempTracker software to freeze, so that the devices could not upload data even after airtime had been replenished.

Early in the project, such disruptions were typically seen as calls to redesign the device or user workflows. However, efforts to establish accountability and role clarity had generated growing attention to categories of “user error” and “device breakage,” which would be accounted for by local staff and by engineers in California respectively. For malfunctions with a substantially ambiguous or mixed origin, there was now growing pressure to blame human error, which presumably local staff could more readily address sustainably, rather than interpreting these malfunctions as instances of material back talk that would necessitate further redesign of either routines or devices.

The pressure to categorize accountability was so great that a presentation for the ministry of health, sent in an email with the researcher cc'd, summarized these problems as follows:

The most common problems were due to user-errors... The current problems are not in the technology but in the deployment plan, the roles and responsibilities of all the parties involved, and the procedures around maintenance and support. These should all be strengthened to complement the current infrastructure of the Ministry of Health.

There is a certain factual accuracy to this statement: the problems were not exclusively in the devices so much as distributed throughout the situated practice as a whole. For the design team this seemed patently obvious because these particular break downs had never materialized during extensive testing, admittedly under ideal conditions, in California. This episode shows that while material back talk has some

objective reality apart from any person's believing in it yet, it is also enacted in practice rather than being a fixed feature of any one object. As a result, considerations about which aspects of a practice might be reconfigured to accommodate material back talk hinge on subjective judgment and organizational pressures.

This one-sided formal conclusion marked a shift in the design process, looking beyond technology design with a view to establishing new roles and routines for the sake of achieving a more coordinated, effective vaccine cold chain. However, this was not a shift away from technology design. Despite their formal decision to draw attention to user error, the design team remained aware that in the ambiguous case above, poor connectivity and not replenishing airtime had led to cases of device breakage in ways that were irreversible and opaque to ordinary users. For pragmatic reasons, they continued working to clarify the nature of the bug and to address it through changes to the software codebase.

In summary, later in the project the design team faced growing pressure to categorize break downs and, despite indeterminacy of causes and effects, to delineate which parties would be accountable for addressing them in the future. When we consider how the design team spoke about their ongoing work, particularly in formal presentations, they tended to make clear distinctions between organizational intervention and technology design. Yet in their practice of recognizing and responding to instances of material back talk they demonstrated an acute sense for the performance of their intervention as a whole. Responding to material back talk by redesigning the maintenance role suggests that they were attending to the evolving relations among technology and situated work as much as they were attending to the inherent features of either considered as separate entities. Upon extended reflection, we have come to describe their design process as a matter of guiding the emergence of sociomaterial practices. In the following section we consider several themes that span these three narrative episodes and offer our inductive insights about how this process happens.

3.6 Case Analysis

Each of the narratives above illustrates how the imbrication of human aims and material back talk shapes the emergence of new practices. We can also identify certain recurring elements that were important in each of these rounds of imbrication. Considering these recurring activities in more abstract terms, we identify key conceptual building blocks that could be used to understand similar processes of imbrication in other contexts. These activities include: (1) Implementation and situated use of prototypes; (2) Experiencing practice break down; (3) Identifying material back talk as a source of practice break down; (4) Accommodating material back talk; (5) Reconfiguring material artefacts or/and worker routines; and (6) The ongoing performance of new practices.

In our case this cycle of imbrication occurred repeatedly, with prior imbrications laying the groundwork for subsequent imbrications in what Leonardi (2011) calls a chain of imbrications. There is a temporal flow to this process, yet the activities should be regarded as mutually constitutive rather than self-contained or sequential. And while designers played a consequential role, they clearly did not predict or control the course of these narratives. To underscore this point we refer to the proactive kind of imbrication observed here as designing for the emergence of sociomaterial practices, in contrast with a notion of simply designing sociomaterial practices, which might ascribe more control or prescience to designers.

In Table 3 we synthesize key observations from each sub-section of our Findings and organize them to show that each episode is an illustrative case of this general process. Each row of the table draws observations from a single episode, while each column features observations from all three episodes that pertain to a single conceptual building block. We now explain these conceptual building blocks in further detail.

Table 3.2: Designing for the emergence of sociomaterial practices

Activities recurring in all episodes	Implementation & Use of Prototypes (Beginning imbrication, enacting back talk)	Practice Break Down (Adverse experiences in unanticipated situations)	Investigating Break Down (Sources included material back talk)	Accommodating Material Back Talk (Exploring preferable tech and routines)	Reconfiguring Artifacts, Routines (Tech & routines emerge, guided by design goals)	Performance of New Practices (Shaped by imbrication of materials, human actions)
Data from narrative 1:	TempTracker prototypes installed, begin sending temperature alerts, nurses respond or/and mobilize others to respond to cold chain disruptions	Nurses report that some alerts were inaccurate, and online dashboard shows that temperature readings occasionally spike more sharply than seemed attributable to actual temperature variations	Placing foam blocks on temperature sensors to buffer them from cold surfaces did not address inaccuracies. Cause was ambiguous until engineers speculatively reproduced electrical noise in lab	Confirmed hypothesis that headphone jack design was picking up stray electrical noise in Kenya that had not been present in California, and that readings could be filtered with a new algorithm	Designed and built software algorithm to filter effects of electrical noise out of temperature readings	Deployed updated software for more reliable alerts, trained additional health workers on new routines for coordinating responses to cold chain disruptions
Data from narrative 2:	Nurses now receive real time SMS alerts but are not always available to see or respond to them. Also, monthly reports were designed for managers but in practice they prefer real time alerts	Managers at Ministry of Health are enlisted in responses to cold chain disruptions through timely phone calls or by subscribing to SMS alerts, but the latter raises scrutiny/accountability concerns among nurses	Proposed to delay SMS alerts to managers by 24 hours. This revealed that managers were concerned with a material limit: vaccines degrade rapidly, imposing a strict timeline on responses to cold chain disruptions	Nurse accountability concerns about being monitored in real time were balanced with the material constraints of vaccine degradation, resulting in the design of an "escalated alerts" feature	Built escalated alerts feature, configured it to alert managers 30 minutes (fridge too cold) or 6 hours (fridge too hot) after cold chain disruption.	Deployed updated software, managers began receiving escalated alerts and calling nurses to initiate responses to sustained cold chain disruptions
Data from narrative 3:	Nurses and managers began coordinating responses to cold chain disruptions via real time & escalated alerts. Doing so required nurses to add mobile network airtime, and tech support from Nexia/Modic Mobile	Clinic visits revealed a pattern of "frozen" software at clinics where devices were accumulating temperature data for weeks without uploading it to internet	Upon deleting data backlog and rebooting devices, they functioned as normal. This confirmed that data backlog was contributing to the software freeze	Initially emphasized changes to user behavior (be sure to replenish devices with mobile network airtime) rather than technology redesign	Attributing the episode to "human error" shifted focus from reconfiguring technology to retraining, establishing more consistent patterns of action	The local TempTracker support role that emerged had as much to do with retraining and promoting key work routines among nurses as it did with technical maintenance of TempTracker devices

3.6.1 Implementation and Situated Use of Prototypes

We begin each of the narrative episodes above with implementation and situated use of prototype technologies in a particular local context. In contrast with other recent studies that have explored the concept development stage of design work that precedes functional prototyping (Stigliani & Ravasi, 2012), we use the metaphor of imbrication to focus on the kind of contextually embedded design work that can only take place once technology has enabled provisional new ways of working. This is important because it is through enacting new ways of using technology that health workers simultaneously enacted surprising forms of back talk. These included faulty temperature alerts (episode 1) and data backlog errors (episode 3) that had not been enacted outside of the context of actual use (during laboratory testing).

While the design practitioners with whom we worked did not use the terms material back talk or emergence themselves, an awareness of these phenomena was clearly implicit in their work. TempTracker devices were nominally functional during the eight facility pilot recounted in episode one above, yet nurses and TempTracker implementers discussed at length that both the technology and the new ways of working

that it might enable were liable to change. The purpose of this initial, situated use of technology was to discover what changes were appropriate to the unfolding situation. In light of the highly exploratory character of this activity, for practical purposes it began with a relatively small number of devices/users and was discussed as “piloting;” the technology design team often spoke of taking TempTracker “from the lab to the field” in order to “see how the technology breaks.” In this sense, novel approaches to technology enabled work were regarded as provisional, undertaken for the practical purpose of generating grounded insights and the emergence of unanticipated turns in the unfolding design process. This emphasis on pursuing iteration and course correction without foreordaining the form or path that it would take was retained through episode two. However, as we will discuss below, it began to recede with the wrapping up of formal design work in episode 3.

3.6.2 Experiencing Practice Break Down

The second activity, experiencing practice break down, consisted of registering patterns of puzzling or unappreciated consequences related to use of prototypes. In our case the design team actively sought to discover and document worker experiences of practice break down, for example through interviews, focus groups, visiting remote clinics for hands on troubleshooting, scrutinizing the online dashboard and making phone calls to clinics where data was not uploading. Despite this proactive attention, break down often emerged ambiguously rather than presenting itself in the form of a problem ready for solution. For example, nurse reports of faulty temperature readings (episode 1), their intuitive skepticism about accountability issues (episode 2) and software freezing due to data overload (episode 3) were all repeatedly heard or observed in some sense by members of the implementation and design team before they were registered as recurring patterns of significant disruption. Drawing on phenomenological treatments of practice break down is helpful here because this work emphasizes that varying degrees of disruption can engender varying degrees of surprise, unreflective workarounds or more conceptual attention to sources of break down. While total disruption of a practice may be obvious, designers are often in a position to allow themselves to notice and investigate more minor instances of practice break down, or not, in accordance with their goals, skills and habitual ways of working.

3.6.3 Investigating Sources of Practice Break Down

In each of the episodes above, awareness of practice break down began with a relatively undifferentiated flow of reports from nurses about “broken gadgets,” complemented by observations about which devices were not uploading data to the server. Differentiating this flow into lists of recognizable kinds of recurring problems involved a kind of design-oriented investigative work. For example awareness that software was freezing on multiple devices preceded awareness that it was occurring specifically on the subset of devices that had remained functioning continuously but without connectivity, and later still the implication that it was only occurring on devices with a data backlog of a particular size (episode 3). On more than one occasion, forms of back talk were investigated through efforts to recreate them. For example, creating electrical noise in the lab in California, and observing that doing so generated faulty temperature readings of a recognizable pattern, was taken as evidence that similar faulty readings in Kenya had indeed been the result of electrical noise (episode 1). In general this work was probing and analytical, directed toward convergence or agreement regarding the attributes that characterize a particular form of break down.

It bears mentioning that we have purposively selected episodes of practice break down that ultimately were attributed, at least in part, to material back talk. This is not to say that material back talk was the only meaningful source practice break down, but rather, more simply, that it is an important source. It is also important to note that while episodes 2 and 3 above involved unforeseen imbrications of device materiality and local routines that pre-existed the TempTracker initiative, all three episodes involved some level of interaction of device with local infrastructure. In episode 1 designers were forced to deal with the materiality of the local electrical grid, in episode 2 the materiality of vaccines and the pace of biological degradation, and in episode 3 the nominal internet connectivity at some health clinics. For this reason, the notion of material back talk affords a wider range of view than notion of constraints, at least insofar as perceptions of constraint are limited to the materiality of IT artefacts. In our analysis of material back talk, the imbrication of multiple kinds of materials in complex practice is a clear theme that will we discuss further below.

3.6.4 Exploring Ways of Accommodating Material Back Talk

On several occasions, moves to clarify the nature of some particular kind of practice break down proceeded through provisional attempts to accommodate it. For example, placing foam blocks on the tips of temperature sensors was a kind of improvised ‘hack’ that, if it had been followed by a change in the pattern of faulty temperature readings, would have been taken as affirmation of the working hypothesis that faulty temperature readings of episode 1 could be attributed to the sensor coming into contact with ice on the inside of a fridge. In other cases, talking with technology users about proposed responses to break down led to insights based on their familiarity with important routines and concrete material constraints. For example in the case of the escalated alerts feature (episode 2), the design team perceived an initial practice break down in nurse-supervisor accountability relations as a consequence of managers receiving real-time alerts. It was only after proposing to address this practice break down with an SMS alert delayed by 24 hours that the design team came up against material back talk related to the rigid temporal pace of vaccine degradation.

The importance of on the spot experimenting and clarifying problems through provisional attempts to address them underscores how this probing form of design-oriented inquiry differs from more passive modes of observation and interpretation. One result of this way of working is that the temporal ordering of investigating back talk and exploring possible reconfigurations may be quite ambiguous. They may even proceed through the very same actions, but it remains worthwhile to understand their ends as conceptually distinct. Investigating break down is analytical and seeks convergence around an idea of where and how a particular kind of disruption emerged, while exploring reconfigurations is generative, with provisional solutions reflecting the emergent character of the back talk they address. While we could depict designers as the sole agents driving the generative part of this process, we instead call this work a kind of accommodation to emphasize that the problems, puzzles and difficulties they addressed had emerged in the recurring performance of devices and users in particular contexts. Thus in some sense users and the materials of the situation set the terms of imbrication, producing particular kinds of emergent complexities before designers could address them through further iteration.

3.6.5 Reconfiguring Artefacts and Routines

A fifth activity entailed rebuilding prototypes to accommodate concrete experiences of material back talk, with the aim of guiding the emergence of new practices. For example the escalated alerts feature (episode 2) materialized and eventually would become integral to new routines for coordinating responses to cold chain disruptions—new in the sense that this particular managerial routine had not been anticipated during initial building of the device. It is interesting to note that after identifying nurses' concern with scrutiny as a priority and the pace of vaccine degradation as a hard limit, changes were made in the software to configure the timing and scheduling of alerts, and in the ostensive patterns of action that these alerts were intended to support. Similarly, when faulty temperature readings were attributed to the electrical grid, the engineering team designed a software algorithm to address the problem, rather than trying to change the electrical grid. And our third episode shows how attributing a particular instance of back talk to human error can influence the kinds of material and activity reconfigurations that are, or are not, explored. In this way there is a fuzzy link between sources of and solutions to material back talk. There is an emergent character to the complexities designers must confront, and yet technology designers do guide the course of this process of emergence insofar as they determine how each instance of material back talk will be addressed.

Creating ancillary resources such as training manuals and trouble shooting guides is also characteristic of the work we call reconfiguring materials. In our case the design team was well aware that they could not establish new patterns of action by decree, yet the discussion and building of artefacts such as training materials was clearly predicated on the intention of changing patterns of action in concrete ways. In the first episode above, the design team accommodated material back talk by building an algorithm while more or less validating the routine manner in which they had previously imagined that nurses would use the technology. In contrast, design of the escalated alerts feature was predicated on the future performance of manager routines that would be new to this workplace, and additionally, had not been anticipated by designers in earlier iterations of their work. This move in the design process also involved dropping some major features and attendant routines that had figured prominently in earlier specifications, in particular the aggregate data visualization tools and monthly

monitoring activities that designers initially had expected managers to perform. In the third episode, discussion of a data backlog error played a prominent role in determining the necessary skillset and writing the job description for local maintenance staff, a role which had only been imagined in foggy form prior to concrete encounters with actual routine problems.

3.6.6 The Ongoing Performance of New Practices

In some cases the implementation of reconfigured technologies and the ongoing performance of a new practice generates new experiences of practice break down. For example faulty temperature alerts during the eight facility pilot in episode one were addressed by building a new algorithm, which became integral to the updated devices that were later implemented at more than forty facilities. It was only with this larger round of implementation and increasing confidence in the accuracy of the SMS alerts that a more noticeable number of nurses began voicing concerns about real time scrutiny—the practice break down recounted in episode two. In this way we can picture building artefacts, implementation and evaluation of break downs as a continuous and ongoing process, what Leonardi (2011) calls a chain of imbrications. In such situations, the ongoing performance of new practices may bear a great resemblance to the implementation and situated use of prototypes with which the process of imbrication began.

In some organizations, major products such as the Linux operating system and Wikipedia are perpetually being redesigned and improved, without any intention of arriving at a complete and final version (Garud, Jain & Tuertscher, 2008). However in many organizations, investments in design work are likely to recede at some point in a project. If the intervention is considered sufficiently robust or validated, implementation may proceed without such deliberate ongoing redesign. This may be particularly true of ICT4D projects that are donor funded and subject to inflexible timelines. In our case, this relative stabilization of practice began in episode 3 and was marked by discussing technology ‘products’ rather than ‘prototypes’ and formalizing long-term maintenance roles so that troubleshooting tasks could be ‘handed over’ from the design team to local Ministry of Health staff.

This is not to say that patterns of action henceforth become static and unchanging, but rather that when people begin perceiving technologies as less subject to change, they may become less likely to attribute a given practice breakdown to material back talk. Users may be asked to resign themselves to minor disruptions as ‘the way things are,’ or break downs may be attributed to human error instead of being treated as generative opportunities for redesign. In some cases glossing over an instance of material back talk may have little serious consequence; people are quite adept at improvising workarounds to accommodate the quirks of technologies that do not precisely fit their preferred uses. Yet in other cases unaddressed instances of material back talk could have serious consequences, such as the breakage, nominal use or outright rejection of technology. The data backlog bug described in episode 3 materialized in just enough devices that, had it not been explained or addressed in some manner, it might have caused Ministry of Health leadership to lose faith in and discontinue the whole project. We depict the ongoing performance of new practices as at least potentially distinct from the situated use of prototypes to recognize that the process of imbrication can only continue in the manner described here as long as technologies are subject to ongoing changes.

3.7 Discussion

In summary, our study offers two novel findings: (1) we identify six overlapping activities that characterize designing for the emergence of sociomaterial practices and (2) we elucidate how this process of imbrication is shaped by the emergent enactment of material back talk, yet also guided by ongoing design work. We now discuss these findings in terms of the contributions they make to IS design research and the ICT4D literature.

3.7.1 Sociomaterial Practices in IS Design Research

For IS research generally, the novelty of our contribution lies in the particular manner that our analysis integrates the concepts of imbrication, practice break down and material back talk. In Leonardi's (2011) seminal work on how human and material agencies imbricate to produce sociomaterial practices, perceptions of a technology's constraints are taken as practical evidence of material agency. Through reference to specific empirical examples, perceptions of affordance are closely associated with the agency exercised by technology users with respect to how they enact practices. In this

sense, constraints and affordances are relational, existing between people and an artefact's materiality (Leonardi 2011).

This relational analysis of affordances and constraints helps to explain how they may change across different contexts of use even where a technology's materiality does not change. However, our case highlights that the performance of devices is contingent not only on user goals; it is also contingent on material infrastructure which was remarkably different in Kenya than in California. The great differences in infrastructure between these two settings, and the way these differences have informed our insights about the process of imbrication, demonstrate the value of using ICT4D studies to inform IS research theories more generally. In the ICT4D context, it is quite clear that we can expand our understanding of material agency by considering not only users' perceptions of an IT artefact's constraints, but also the manner in which material back talk often emerges at the imbrication of devices and infrastructure.

We can similarly expand our view of human agency, beyond the perceptions of technology users, by clarifying how the agency of technology designers matters. In our case, designers were deeply engaged in contexts of use and acutely aware of the concrete material limits to their agency. Nevertheless they played a more consequential role in guiding the emergence of practices than designers have been accorded in recent studies of imbrication. In investigating practice break downs and later accommodating back talk, designers acted skillfully and in accordance with their own goals for the project.

This is not to say that users' initial perceptions of affordance and constraint were inconsequential in the process of imbrication. Rather, we highlight that when people move to enact a certain practice, based on an implicit perception of a technology's affordance, they may be surprised by experiences of practice break down which cause them to reflect on their initial perceptions. In our case and likely in many others, technology users look to designers for support with investigating such experiences. Together they may attempt to make true a perception of affordance, enlisting designers to reconfigure technology so as to better align with an initial perception (episode 1). Alternatively designers may interpret material back talk as a previously imperceptible constraint and accommodate it by changing role definitions (episode 3) or technology features and routines (episode 2). Through these skillful judgments about how to accommodate particular instances of material back talk, designers can play an

important, agential role in guiding the emergence of sociomaterial practices. To be sure, designers cannot control the emergent complexities that so often arise when people begin using their prototypes, but they can respond to them when they arise in practice.

An important implication of this novel analysis is that, by foregrounding the perspectives and work of designers in the emergence of sociomaterial practices, we have extended the notion of imbrication to be more amenable to forward-looking approaches to design research. Our findings are particularly relevant to context-aware frameworks such as Action Design Research or ADR (Sein et al., 2011). Our analysis aligns well with and seeks to illuminate further ADR's call for continuous iterative cycles of building artefacts, organizational intervention and evaluation. As we consider how to move from our inductive analysis to prescriptive guidance for future design efforts, ADR's notion of guided emergence is highly salient. Guided emergence suggests that design researchers "should (a) consciously guide the design of the artefact, and at the same time, (b) allow the artefact to emerge via influences from the organizational participants." Embracing guided emergence involves going beyond the classical tool-view (Hevner, Ram, March & Park, 2004) implicit in much IS design research. For this reason ADR introduces the notion of ensemble artefact, as follows (Sein et al., 2011 p.38):

By ensemble artifact, we specifically mean the material and organizational features that are socially recognized as bundles of hardware and/or software (Orlikowski and Iacono 2001). This definition reflects a "technology as structure" view of the ensemble artifact, where structures of the organizational domain are inscribed into the artifact during its development and use (Orlikowski and Iacono, 2001).

By embracing a "technology as structure" view and emphasizing the reciprocal shaping of artefacts and organizational contexts, ADR holds that the materiality of ensemble artefacts is recognizably distinct yet in practice inevitably intertwined with human action. When pushed to clarify their understanding of ensemble artefacts in subsequent work, the authors state, "we suggested that IS scholars' domain of intervention should be the ensemble artefact, i.e. not only the hardware-software instantiation but also the work practices of organizational participants relevant to the context in which the IT-artifact is realized" (Purao, Henfridsson, Rossi & Sein, 2013 p.77). There is some analytical tension here, with ensemble artefacts implying a domain of intervention that includes guiding the emergence of new ways of working. Yet with

respect to conceptual reflection, ensemble artefacts remain associated with materiality and located in the realm of structure; related to but still outside of the realm of actions which the ADR practitioner's interventions are liable to change.

Our work offers a step towards resolving this tension by theorizing the process of imbrication through which human activity and materiality become intertwined. As with prior work on imbrication (Leonardi, 2011), we can consider material artefacts as existing within the realm of structure and people's activity as existing within the realm of action, yet shift the unit of analysis away from the properties or impacts of discrete entities and onto their process of interweaving. The notion of sociomaterial practices implies this shift in analytical focus. It suggests that designing for emergence should be open not only to the contributions of organizational members, but also responsive to the complexities and concrete instances of material back talk that inevitably arise in practice. It offers a nuanced and more holistic framing of what emerges when artefacts and patterns of action imbricate through ongoing cycles of building, intervention and evaluation.

3.7.2 Unpacking 'Context' in Research on ICT for Development

As Walsham (2017) notes, the significance of context is a theme of early and lasting importance in the ICT4D community. Robey, Gupta and Rodriguez-Diaz (1990) argued that social context and cultural barriers to implementation present greater difficulties than technical issues, and Walsham, Symons & Waema (1988) similarly argued that IS should be conceptualized as social systems in which computing technologies are but one dimension. Researchers have explored issues of local adaptation versus standardization (Walsham & Sahay, 2006), indigenous development of ICTs (Bhatnagar, 1990), and participatory design as a means of overcoming contextual challenges (Korpela, 1990; Braa & Sahay, 2012).

While these studies have offered major contributions to our understanding of ICT4D initiatives, Nicolini (2012) and other practice theorists have observed that in IS and organizational research generally, context can also be overused as a catchall term to a point where it loses analytical purchase. In this view, 'context' is not a satisfactory explanation of why technology implementation evolves or goes awry. Rather, context is itself a phenomenon that needs to be explained and conceptually unpacked. If we

maintain that context matters, and yet acknowledge that ‘context matters’ has become a truism in ICT4D, then there is a clear need for better conceptual tools to clarify the specific ways in which concrete features of local context become consequential in particular cases.

Our notion of designing for the emergence of sociomaterial practices offers a fresh perspective on context in two ways that are useful to ICT4D research. First, it highlights that technologies imbricate not only with local ‘social’ context such as cultural norms and ways of working, but also with a range of local materials. While previous research has highlighted infrastructural constraints in ICT4D, we offer a novel analysis of the process through which technology, local materials and human activities imbricate. We show that when instances of material back talk are recognized for their potentially generative role in an ongoing design process, they can result in productive reconfigurations of an IT artefact and enable designers to guide the emergence of new practices. A conceptual understanding of this process enables us to write more specifically about the specific ways that context comes to matter in particular cases—through the imbrication of human aims, imported technology artefacts and the materiality of local electrical grids, communication networks, roads, buildings etc.

Second, our analysis emphasizes that ICT4D practitioners proactively shape, even though they cannot unilaterally control, worker roles and routines. To some degree these organized social dynamics pre-exist ICT4D interventions and are part of the local context which ICT4D practitioners must navigate. Yet they also become integral to the interventions which ICT4D practitioners iteratively refine, document in user guides and training materials, and hope to replicate in other settings. That is to say, practices are “entangled with their contexts, not only shaped by them but simultaneously enacting them” (Howard-Grenville et al. 2015). Our approach in tracing concrete instances of practice break down and material back talk is a nuanced manner of clarifying which particular features of social context become integral to the ongoing performance of ICT4D interventions. By reframing ICT4D interventions as sociomaterial practices, rather than as artefacts, we can more holistically consider the bundles of artefacts and routines that practitioners aim to replicate when they scale their interventions to new contexts.

In this way our analysis of designing for the emergence of sociomaterial practices could inform an ICT4D oriented branch of the research agenda proposed by Monteiro and Rolland (2012) regarding the trans-situated use of integrated information systems. Such research would address the IS literature's blind spot concerning how people accommodate the situated and emergent character of sociomaterial practices, yet nevertheless achieve significant degrees of similarity between sociomaterial practices that are dispersed across a wide range of contexts. Given the focus on 'pilotitis' and frustration with the poor replicability of interventions in the ICT4D practitioner community, such a research agenda seems particularly timely.

3.8 Implications for Practice

ICT4D and global mHealth practitioners continue to struggle with putting design principles into practice (Waugaman, 2016), thanks in no small part to the myriad implementation complexities and coordination challenges that hinder global health and development initiatives generally. Equipped with imbrication, practice break down and material back talk as analytical tools, we hope that ICT4D practitioners may sharpen their perceptual capacities and undertake design and implementation work with greater nuance.

For example, our third narrative episode highlights that deciding when to conclude iterative redesign activities can be fraught for a variety of organizational reasons, particularly when financial resources are scarce. Premature closure of designing can stymie the ongoing performance of a practice, even if the technologies in question are considered "functional" by virtue of their having previously functioned well in other contexts. Generic calls to "think like a designer" (Brown 2008), "involve the user" or "develop projects in an incremental and iterative manner"³² no doubt have merits, but they can be difficult to apply to the unique qualities of particular cases. In contrast, we can cultivate a more situation-specific view of a design project's progress by acknowledging that technologies inevitably imbricate with new contexts of use, that this often engenders unique instances of material back talk and can manifest in practice

³² See The Principles for Digital Development, www.digitalprinciples.org.

break down. The practical consideration shifts from “did we engage users?” or “were there iterations?” to whether instances of material back talk have been investigated and accommodated and whether experiences of practice break down have substantially receded.

To suggest designing for the emergence of practices, rather than simply to design sociomaterial practices, emphasizes that designers grapple with a range of emergent complexities that often evade their foresight in requirements gathering and that remain beyond their control during implementation. Though designers cannot predict or control these complexities, they can adapt to them when they arise, thereby guiding the emergence of new practices. By revealing that this generative process proceeds through concrete conversations with materials and encounters with material back talk, our analysis casts a critical light on efforts to apply design principles while telecommuting or through brief sojourns in developing countries. Insofar as good design involves experiencing practice break down and investigating and accommodating unique instances of material back talk, it is hardly compatible with “parachuting in,” the term many international development practitioners use to describe transient visits by foreign aid workers. In this way our study offers a concrete material basis for undertaking ICT4D design work locally and with the sustained participation of local design partners.

Finally, our view of designing for the emergence of sociomaterial practices has implications for how practitioners treat the challenge of reproducing and scaling successful interventions. Thanks to influences from evidence based medicine (Tomlinson et al., 2013) and development economics (Banerjee & Duflo, 2011), many practitioners espouse the view that global health and ICT4D interventions should be evaluated with randomized trials. This discourse often presumes that once such experiments have proven technologies to be “effective,” reproducing successful interventions in new settings should be relatively unproblematic and users should be expected to comply with the mandates of the evidence base. It has become relatively easy to critique the technological determinism implicit in this perspective, yet such critiques and the maxim “context matters” do not amount to a coherent alternative vision of more appropriate ICT4D design and implementation. By framing ICT4D interventions as complex practices, advancing the notion of designing for the emergence of sociomaterial

practices, and embracing design research frameworks such as ADR, we hope to contribute to such a holistic and pragmatic approach.

3.9 Conclusion

Our ethnographic fieldwork and inductive analysis reveal six overlapping activities through which designers may guide the emergence of sociomaterial practices. We analyse designing for the emergence of sociomaterial practices using the metaphor of imbrication, highlighting the gradual and iterative process by which human and material agencies intertwine and come to produce relatively stable sociomaterial practices. Extending prior studies of imbrication, we use the notions of practice break down and material back talk to offer a more fine-grained and forward-looking view of design work. We draw attention to a wider range of materials, emphasizing that IT artefacts imbricate not only with worker activities but also with material infrastructure. We also highlight a wider range of human agencies, recognizing the agency of technology users as well as the limited yet consequential agency of technology designers.

As we move from inductive insights to more prescriptive guidance, three implications of our work are particularly salient. First, in contrast with most of the literature on sociomaterial practices, we endorse the forward-looking stance of the original design research paradigm. This is to say that IS researchers need not restrict themselves to developing new theoretical lenses for making sense of IT artefacts. They can also undertake the iterative work of designing for the emergence of sociomaterial practices and developing prescriptive design knowledge. Second, in embracing ADR we stress that such design research should not exclude or be limited to the design researchers' own conscious decisions, but should also be open to the contributions of organizational members and responsive to the complexities, break downs and concrete instances of material back talk that inevitably arise in practice. Third, we highlight an opportunity for future ADR projects to engage sociomaterial practices as a domain of intervention and conceptual reflection, examining how "the social" and "the material" become constitutively entangled to produce sociomaterial practices. These points are particularly relevant when it comes to explaining what exactly ICT4D practitioners are accomplishing when they claim to have replicated successful interventions in new settings.

By drawing on and contributing to the literature on sociomaterial practices, we engage a rather philosophical project concerned with challenging the conceptual separation of technology, work and organization (Orlikowski, 2007; Orlikowski & Scott, 2008). Yet our aims and contributions to ICT4D are ultimately more pragmatic in nature. The implementation bottleneck in global health has made it increasingly obvious that context matters and that coherent, alternative visions of more appropriate ICT4D design and implementation are sorely needed. It is our hope that practitioners will reflect on notions of imbrication, practice break down and material back talk, sharpening their perceptual capacities and ultimately designing for the emergence of sociomaterial practices with greater nuance.

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3.11 Chapter 3 Appendix

Photographs played an important role in our fieldwork and helped convey a detail-rich sense of the field to the second author during analysis and writing. Upon presenting our work, we often received feedback that photographs convey something important about our case that is distinctive in IS and organizational scholarship. In the spirit of exposing the mainstream IS research community to distinctive features of ICT4D initiatives, we offer the following photographs as a complement to our manuscript.

Figure 3.1: A nurse holds thermometers above an open vaccine fridge.



Behind the tray of vials, ice has accumulated on a cooling element. Temperature readings might be inaccurate if the temperature sensor were placed against the ice or the cooling element.

Figure 3.2: A blue vaccine fridge



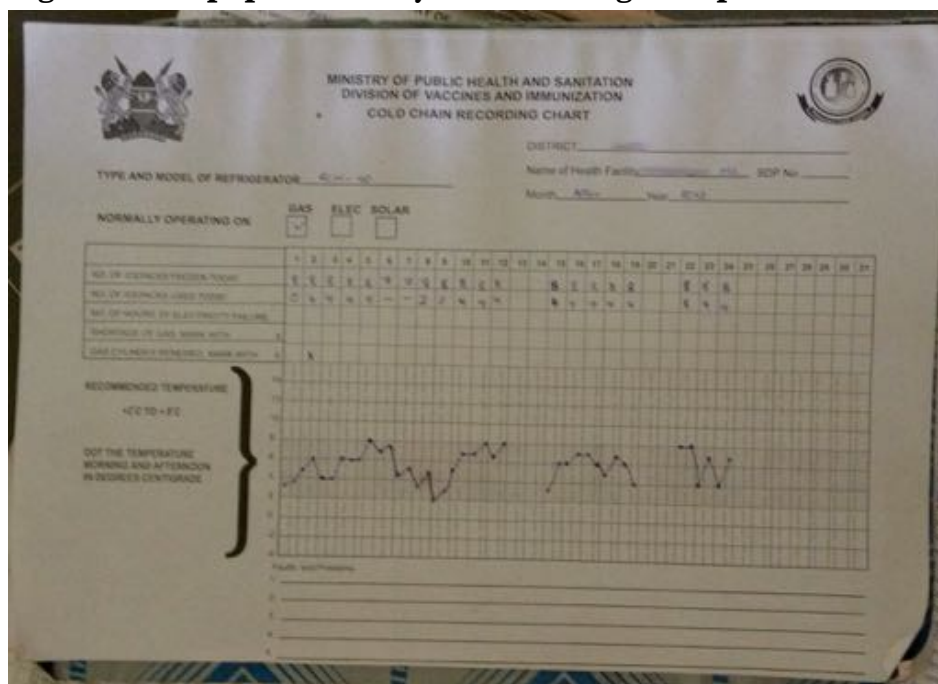
To the right of the fridge, a propane tank for when the electrical grid goes out. On a stool to the left of the fridge, a TempTracker Device. On the far left, a grey cooler for storing vaccines to be used during a single day. Behind the day cooler, a green bucket with a faucet—the only source of water for hand washing at this health facility.

Figure 3.3: Chalk board as analogue health information system



While mobile phones have become widespread in recent years, most information systems in the Kenyan health service are still analog. This outdoor chalkboard is used by community health workers and public health officers to track immunization rates in a particular community.

Figure 3.4: A paper monthly vaccine fridge temperature chart



Facility staff members are expected to record fridge temperatures on charts such as this at 8am and 4pm, seven days a week. Here, the 13th, 14th, 20th and 21st (weekends) are blank, which was not an uncommon occurrence during clinic visits.

Figure 3.5: The public area in front of a typical rural clinic



Figure 3.6: Close up of first generation TempTracker prototype



Android smartphone sits inside a hard plastic case, with one wire running to an electrical outlet and one to the temperature sensor inside the fridge. The metal ‘cages’ and locks were added during implementation as part of the prototyping process.

Figure 3.7: A second-generation device and related equipment



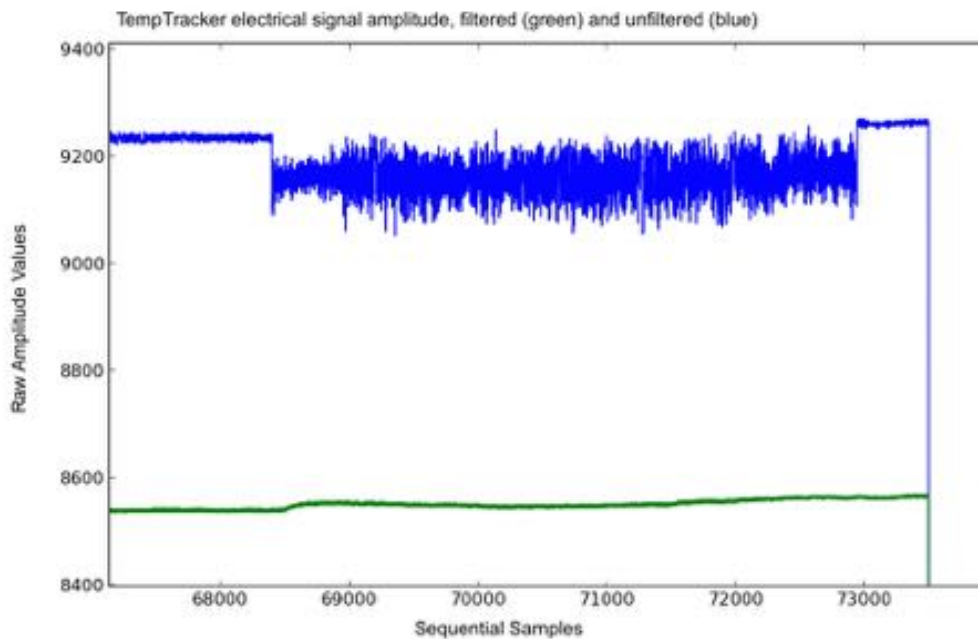
Over time a growing number of items became part of the standard kit, including laminated standard operating procedures, a trouble-shooting guide, a surge protector, a cage, locks and keys, hooks for placing the temperature sensor within the fridge, plug adaptors, airtime, SIM card, and form for registering the SIM card.

Figure 3.8: Poor roads, floods often delayed travel to rural facilities



Such transportation challenges are an ordinary feature of Kenya's rural immunization program, and can be particularly problematic when facilities need emergency assistance.

Figure 3.9: Testing the algorithm that filters noisy electrical signal



Blue depicts unfiltered, while green is filtered. A few seconds into the test, multiple halogen lights and a wall heater were turned on near the TempTracker device, and the unfiltered blue signal became less precise as stray electrical signal was picked up by the headphone jack. Image courtesy of Nexleaf.

4 SENSEMAKING IN THE FLESH: A PRACTICE PERSPECTIVE

Isaac Holeman, Mark de Rond, Jennifer Howard-Grenville³³

This study examines how people make sense of novel, unanticipated or confusing experiences, responding in practical ways to uncertainty and change. Despite significant advances, empirical studies of sensemaking have tended to depict the phenomenon as a cognitive process centred on interpretation. While Weick's early work positioned sensemaking more holistically as arising from immersion in the stream of experience, reliance on archival data and retrospective interviews may have contributed to today's relative neglect of action and the bodily senses. In this paper, we rely on a unique ethnography of a world-first attempt to scull the navigable length of the Amazon river. Drawing on extensive video data, we were able to document the concrete work of sensemaking as it unfolded in response to serious risks, routine uncertainties and puzzling surprises.

³³ This paper is the culmination of a highly collaborative effort spanning several years. Our analysis is based on fieldwork conducted by MdR as well as many videos recorded by other rowers. IH coded video data and led the writing process. All three authors remained closely involved throughout an extended, iterative process of analysis, writing and revision of the final manuscript.

Our three empirical findings relate to 1) the bodily task of sensing our way into action; 2) how action is situated in the material world; and 3) the provisional character of sense, the making of which is a skilled and ongoing accomplishment. These interrelated findings sketch a tactile notion of sensemaking that we call sensemaking in the flesh. We use this phrase to suggest physical presence as well as a connotation of contact and materiality that transcends human bodies—to flesh out is to add substance. In the flesh also suggests studying sense and sensemaking activities at their point of production. Drawing attention to pragmatist and phenomenological influences in Weick's (1995) seminal work on sensemaking, we argue that practice theoretical perspectives, ethnographic methods and the use of video data might ameliorate several recognized shortcomings in recent sensemaking research.

4.1 Introduction

On September 13 2013, three amateur oarsmen launched an ocean-going rowing scull in Nanta, Peru and set off to row the approximately 2,077 miles of the Amazon river. Such a voyage had never previously been completed. Two of the oarsmen spoke neither of the useful languages (Spanish and Portuguese), the boat had been badly damaged in transit and needed bailing out continually, and the three were unarmed and unprotected on a river known for piracy and narcotics trafficking. Over a period of 31 nights and days of continuous rowing, coordination and safety, scheduling and speed, the resupply of foodstuffs and handling of conflict had to be worked out on an ongoing basis. Given its emphasis on how “people work to understand issues or events that are novel, ambiguous, confusing, or in some other way violate expectations,” (Maitlis and Christianson, 2014, p. 57) one might reasonably expect that the sensemaking literature would have much to say about how the voyage unfolded. And yet, our analysis of several hundred hours of video footage of the voyage, as well as field notes of one author who “perform[ed] the phenomenon” under study (Wacquant, 2015, p. 1), revealed aspects of their sensemaking that are poorly accounted for in the sensemaking literature's recent emphasis on cognition and interpretation. For example, it failed to underline the critically important roles of body and materials, nor did it highlight the “unresolved” nature of sensemaking insofar as sense made is only ever provisional, oriented toward making progress, and thus subject to change.

While Weick's (1995) original formulation of sensemaking left ample room for it to occur in an embodied manner and through the flow of action, recently sensemaking has been more narrowly defined as "turning circumstances into a situation that is comprehended explicitly in words and that serves as a springboard for action" (Maitlis & Christianson, 2014; Sandberg & Tsoukas, 2015; Weick, Sutcliffe & Obstfeld's 2005, p. 409). Our video analysis suggests that time and again action would precede talk, and that sensible courses of action – meaning those that afforded progress on the river – frequently unfolded in the absence of conversation or explicit, spoken guides to action. Instead, the oarsmen felt their way through currents and eddies, responded through their various senses to shifts in the weather, the challenges of rowing at night with unseen barges, or damage to their boat from grounding on sandbanks. They moved forward through circumstances – including the sudden departure of the third rower mid-voyage—that exacted an accumulating toll on their physical health.

We use our analysis of the journey to explore the significance of bodily presence and contact with concrete material situations in sensemaking. Our analysis of the video data revealed in real time the unfolding of ambiguous and seemingly mundane situations, and the orientations of the rowers' bodies and material artefacts to these situations. We develop insights into how sensemaking is accomplished through bodily senses, how deeply it is situated in and shaped by the material world, and how it unfolds as an ongoing accomplishment, not only in discrete episodes such as disasters and organizational change initiatives, but more broadly in skilled action.

Our work has several implications for the sensemaking literature: i) we restore attention to perception and action in sensemaking, not just interpretation, by re-situating meaning in ongoing practical action; ii) we recast 'enacting a sensible environment' as a sociomaterial enactment rather than a largely mental affair, and iii) we revisit the ongoing character of sensemaking practices in light of pragmatic and phenomenological influences in Weick's (1995) early work, with particular attention to the methodological challenges of documenting practices as they unfold.

4.2 Theoretical Background

In their review of the literature, Maitlis and Christianson note "considerable variation" (2014, p. 62) in how sensemaking is defined, but find four common themes.

These include: i) that sensemaking is a process, meaning that it unfolds over time; ii) that cues play a central role in triggering and shaping sensemaking; iii) that it is social; and iv) that it concerns action, insofar as a sense of the situation enables people to act. Maitlis and Christianson offer a composite definition that includes these features, asserting that sensemaking is:

a process, prompted by violated expectations, that involves attending to and bracketing cues in the environment, creating intersubjective meaning through cycles of interpretation and action, and thereby enacting a more ordered environment from which further cues can be drawn. (2014, p. 67)

This definition reaffirms the three analytically distinct moves others have been labelled as central to sensemaking: noticing or bracketing cues, interpreting them, and taking action (Daft & Weick 1984; Thomas, Clark & Gioia, 1993).

To date, however, sensemaking scholars have paid much more attention to the interpretation of cues than to how they are noticed or to their entanglement with action. In their review of the literature, Sandberg and Tsoukas conclude that 84% of the studies “do not seem to make a distinction between the ‘creation’ and the ‘interpretation’ process but treat them as one and the same. In this way, processes of sensemaking become synonymous with processes of interpretation” (2015, p. 14).

Further, the focus on interpretation gives the sensemaking literature its distinctly cognitive character, with some studies focusing explicitly on how sensemaking updates or challenges cognitive schemata (Balogun & Johnson, 2004; Elsbach, Barr and Hargadon, 2005; Lüscher & Lewis, 2008; Starbuck and Milliken, 1988). For example, Baloguna and Johnson (2004) document how sensemaking of an organizational change occurs through the conflict and negotiation of schemata between groups affected by the change. Other work takes a more social constructionist perspective, asserting sensemaking unfolds “in the discourses of social members—the intersubjective social world—rather than simply occurring in their minds” (Gephart, 1993, p. 1470; quoted in Maitlis & Christianson, 2014, p. 95). Here, the emphasis is on how discourse and interaction guide sensemaking as it emerges between leaders and organizational members (Corley & Gioia, 2004; Maitlis, 2005; Maitlis & Lawrence, 2007; Pratt, 2000; Sonenshein, 2010). Still, the sense that is made in these studies is discussed in terms that foreground cognition. For example, Corley and Gioia describe how identity ambiguity

in the wake of a spin-off is managed through new meanings that surface “from the events, actions and discussions within the organization about who the organization is becoming” (2004, p. 200).

This predominance of attending to interpretation and foregrounding cognition in studies of sensemaking stems from at least two sources. First, it is methodologically easier to study interpretation and the construction of meaning through narrative and discursive traces. Noticing and acting, on the other hand, are situated and fleeting, and less amenable to accurate post-hoc representation. Second, interpretation fits readily with other intersubjective meaning-making processes that organizational theorists connect with sensemaking, including individual and collective identity (Corley & Gioia 2004; Maitlis 2009; Pratt, Rockmann & Kaufmann, 2006), organizational change, leadership, negotiation and power, and framing (Abolafia, 2010; Balogun & Johnson 2004; Rouleau & Balogun, 2011; Sonenshein 2010). As a result, it perhaps should come as no surprise that the bulk of work on sensemaking draws on data that can be captured in words and is concerned with how those words shape others’ interpretations of events or developments. As Maitlis and Christianson observe, “most current accounts of sensemaking describe sense as constructed in language and shared through narrative.” (2014, p. 99).

This emphasis obscures important characteristics of sensemaking from Weick’s early formulations of the construct (1995). Enactment, that people “act their way into sense” (Weick, 2009, p. 130), was positioned as central to sensemaking. However, action, whether cause or, more frequently, consequence of sensemaking only appears explicitly in 15% of the sensemaking studies reviewed by Sandberg and Tsoukas (2015). Acting is related to other aspects of sensemaking in three ways (Maitlis & Christianson, 2014). First, acting probes the world for cues, which are subsequently interpreted; second, actions “test provisional understandings generated through prior sensemaking” (2014, p. 84); and finally, actions shape the environment for sensemaking, a process most in line with Weick’s notion of enactment. Two settings have proven amenable to capturing action in sensemaking: crises, where taking action “involves a trade-off between dangerous action which produces understanding and safe inaction which produces confusion” (Weick, 1988, p. 305, quoted in Maitlis & Christianson, 2014, p. 85), and

temporary organizing, where actions bring to life role structures, hierarchies, and other mechanisms of coordination (Bechky, 2006).

Despite this explicit attention, action largely has been treated as instrumental to rather than constitutive of the sense being made. For example, regarding action as ambiguity-reducing in crisis situations acknowledges that action probes a world of objects and evidence. The actions taken might ‘produce’ a set of outcomes, but do so in a way that presumes cognitive processes intervene to make sense of the cues obtained through action. Consider Weick’s (1988) study of the Bhopal accident, where inaction on discrepant cues, including a strange odour and atypical pressure readings, allowed a chemical reaction to proceed until it was too massive to control. In this case, the chemistry and plant were going to do what they were going to do; the role for human action was to probe, intervene and, ideally, control. Their paper illustrated the importance of actions in probing a knowable world, surfacing inaccurate cognitive frames, and hence consciously redirecting action through more effective cognitive processing (Rudolph, Morrison & Carroll, 2009).

However, such work stops short of investigating how actions can also capture a more immediate, and embodied, “absorbed coping” (Sandberg & Tsoukas, 2015, p. 17). In this latter sense, action and sense are entangled with one another such that interpretation – through cognition – is no longer a necessary arbiter. Seeing action as more fully constitutive of sense thus involves “adopting a more complex ontology than the one that conceives of the world as a collection of objects with specific properties” (Sandberg & Tsoukas, 2015, p. 14). In other words, its involves moving away from the Cartesian separation of mind and body, and object and subject, that implicitly pervades the literature on sensemaking, and towards a perspective, embraced by practice scholars and others, which hinges on “the notion that social life is an ongoing production and thus emerges through people’s recurrent actions” (Feldman & Orlikowski, 2011, p. 1). Sandberg & Tsoukas (2015, p. 14) explain how sensemaking would have a more immanent, immediate, and embodied character with such an ontological shift:

Hence, it is not so much that purposeful actors, equipped with articulated plans, deliberately re-shape their actions by obtaining explicit feedback as they go on with their tasks, as that actors habitually act on the basis of who they historically have been (Sandberg & Tsoukas, 2007, Ch. 4), observe the “backtalk” of their actions (Schön

1983; Yanow & Tsoukas 2009), and obtain a clearer sense of what is going on and who they are, spontaneously adjusting their actions accordingly.

Some scholars have begun to probe this more immanent sensemaking (Sandberg & Tsoukas, 2015), in which the material world is present and consequential (Stigliani & Ravasi 2012; Whiteman & Cooper, 2011), and people's histories, experiences, bodies and emotions are implicated in how they act (Cunliffe & Coupland, 2012; Maitlis & Christianson, 2014; Whiteman & Cooper, 2011). For example, Whiteman and Cooper argue that "ecological sensemaking" relies on a person's experience of a topography, climate, and ecosystem. They contrast Whiteman's lack of embeddedness in the harsh Canadian subarctic environment that led to her slipping on black ice and falling into a river, risking drowning and then hypothermia, with that of Freddy, a Cree trapper who was born and lived his entire life "in the bush." In so doing, these authors assert that people are differently capable of sensemaking in relation to their material environments. However, despite the obvious implicit role of bodies in their analysis (Gail Whiteman is small, inexperienced in walking a trapline, and not strong enough to pull herself out of a current when she is half submerged in the river; Freddy is large, extremely experienced in walking traplines, and strong enough to haul Gail out of the river), the role of bodies and bodily capacities are not explicitly theorized in relation to sensemaking. Instead, Whiteman and Cooper (2011) focus on developing an account of ecological sensemaking, which foregrounds the (sometimes subtle) cues that the natural environment affords, and people's differential capacities to notice and act on those cues.

Cunliffe and Coupland more explicitly consider the role of the body and emotions in their effort to demonstrate that sensemaking unfolds through "embedded and embodied narrative performances" (2011, p. 66). Drawing on a DVD documentary of team's rugby tour and focusing on an event in which a player speaks out about management, the authors analyse the emotions, talk, and gestures of the players as they make sense of the event and its aftermath. By drawing on an edited and produced documentary that captures "multiple interpretations, reactions, thoughts and feelings of the 'actors'" (2011, p. 70) over a two-month period, the authors demonstrate that sensemaking can unfold as a polyphonic and contested narrative. However, their data sources afford a less than immediate experience of sensemaking from the body.

4.2.1 Other Perspectives on Meaning, Materiality and Situated Action

To create analytical room for topics such as bodily skill and material circumstance that have to date been little discussed in the organizational sensemaking literature, our study draws on Suchman's (1986; 2006) notion of situated action. Building on the work of pragmatists such as James and Pierce, Heideggerian phenomenology (Dreyfus, 1991; Heidegger, 1996) and above all ethnomethodology (Garfinkel, 2002), she argues that all action is highly situated. Suchman uses the term situated to emphasize that "every course of action depends in essential ways on its material and social circumstances" (2006, p. 70). Documenting how people account for the concrete material details—or materiality—of a particular situation is difficult because in ordinary activity materials are often dealt with tacitly and can easily fade from view:

Consider the example (used by Wittgenstein, Polanyi, and Merleau-Ponty) of the blind man's cane. We hand the blind man a cane and ask him to tell us what properties it has. After hefting and feeling it, he tells us that it is light, smooth, about three feet long, and so on; it is occurrent for him. But when the man starts to manipulate the cane, he loses his awareness of the cane itself; he is aware only of the curb (or whatever object the cane touches); or, if all is going well, he is not even aware of that... Precisely when it is most genuinely appropriated equipment becomes transparent. (Dreyfus, 1991, p. 65, quoted in Suchman, 2006, p. 73).

In this example the cane disappears from conscious view when it has become integral to the blind man's whole apparatus of perception—his sensorium. However, when the materials that are integral to some practical activity break down, become unavailable or unwieldy, or generate unintended consequences, people can only make sense of their circumstances and "get going again" through more directed inspection and practical problem solving. By documenting how people respond to instances of practice break down in computer supported work, Suchman argues persuasively that shared meanings are "resources for situated action but do not in any strong sense determine its course" (2006, p. 72). Whether people work tacitly or with more conscious attention, she argues that "every instance of meaningful action must be accounted for separately with respect to specific, local, contingent determinants of significance" (2006, p. 84). She illustrates this point further with a salient example:

Although plans presuppose the embodied practices and changing circumstances of situated action, the efficiency of plans as representations comes precisely from the fact that they do not represent those practices and circumstances in all of their concrete detail. So, for

example, in planning to run a series of rapids in a canoe, one is very likely to sit for a while above the falls and plan one's descent. The plan might go something like "I'll get as far over to the left as possible, try to make it between those two large rocks, then backferry hard to the right to make it around that next bunch." A great deal of deliberation, discussion, simulation and reconstruction may go into such a plan. But however detailed, the plan stops short of the actual business of getting your canoe through the falls. When it really comes down to the details of responding to currents and handling a canoe, you effectively abandon the plan³⁴ and fall back on whatever embodied skills are available to you. The purpose of the plan in this case is not to get your canoe through the rapids but rather to orient you in such a way that you can obtain the best possible position from which to use those embodied skills on which in the final analysis, your success depends (Suchman, 2006, p. 72).

Suchman's preoccupation with plans stems from her critique of cognitive science and artificial intelligence research in the 1980s, which had tended to attribute the organization and significance of rational actions to underlying plans. We certainly do not mean to suggest that the sensemaking literature in organization studies has treated "sense" as more or less synonymous with "plans." However, Suchman's broader argument is that "mutual intelligibility is achieved on each occasion of interaction with reference to situation particulars rather than being discharged once and for all by a stable body of shared meanings" (2006, p. 71). Thus her critique is relevant wherever situated action is treated as if it were based on representations, cognitive schemata or "a stable body of shared meanings," without fully accounting for "situation particulars." The challenge for researchers who take this view of situated action seriously is to ground the study of "sense" in the larger context of ongoing situated activity, rather than subsuming the details of action under the study of sense, stable meanings or shared representations.

³⁴ In the second edition of her book, Suchman observes in a footnote, "This phrasing is unfortunate, in suggesting that the plan is somehow jettisoned. It would be better to say that your ability to act according to the plan ultimately turns on the embodied skills available to you in situ, which are themselves presupposed, rather than specified, by the plan."

4.3 Methods

4.3.1 Research setting

We rely on a unique video ethnography of a world record attempt to scull the navigable section of the Amazon over 31 days and nights. This proprietary dataset comprises hundreds of video clips (ranging from a few seconds to well over 60 minutes in duration), dozens of audio recordings, photographs, a field journal, web blog entries, and pre-and post-journey interviews. It is particularly well suited to advancing our collective understanding of sensemaking beyond those features already highlighted in prior empirical work for two reasons. First, the data comprises real time observations on sensemaking derived from video and audio recording equipment in place on the boat during the journey. While some of the video (and all of the audio) data captures the rowers narrating recent events or reflecting on the unfolding journey, recordings were made immediately following disruptive events (often within the hour) meaning that they are in much closer temporal proximity than post-hoc interviews more typical of sensemaking research. Moreover, a substantial amount of the video data is in real time, with the camera running for long periods of time in relatively random intervals. These videos are particularly important in capturing aspects of sensemaking that cannot (or are not yet) put into words.

Figure 4.1: Anton, Mark aboard their boat



On the right side of the boat is the water tight cabin where they often slept. Above the cabin is a tripod where they often left the camera filming for extended periods of time.

Second, because the journey had never previously been attempted in a double scull, it involved a particularly high level of uncertainty and risk: the risk of piracy, the risk of night-time collisions with other river traffic or floating debris, the risk of bacterial infection, the risk of not being able to communicate (since neither oarsman spoke Spanish or Portuguese), the risk of disturbing drug smugglers, and the risk of equipment failure when days away from any substantial human settlement. Given the risks and uncertainty involved, ours is an extreme case – one that acts as a “pressure cooker” in affording maximum opportunity for sensemaking in ambiguous and changeable, high-risk-high-stakes situations, where decisions, once made, would often be irreversible.

The journey began on 13th September 2013 when two Cambridge oarsmen, Anton Wright and Mark de Rond, and their local companion Alvaro, boarded a small vessel in Nauta, Peru. Their aim was to reach Macapá, Brazil within thirty-one days. At over 2,000 miles in length, bendy, and varying in width from 200 feet to 20 miles, the Amazon river is said to be the world’s most dangerous and voluminous with over 1,000 tributaries longer than Britain’s river Thames.

On their first day on the water, the boat sprang a leak and required being pulled into dry dock for repairs. The repairs were improvised and imperfect, using whatever materials were to hand, meaning that the water needed bailing out every two hours for the duration of the journey. As a condition of passage, the Brazilian Navy forced the oarsmen to sign a contract stipulating that they refrain from rowing in the dark. They argued that the risk of piracy and night-time collisions with freight ships was substantial. Since the boat had been four weeks late in arriving, however, the rowers decided they had no option but to keep the boat moving day and night. As we will show later, maintaining boat speed so that they could return to their homes and other obligations would become an urgent practical concern and matter of morale as the journey unfolded.

So as to mitigate the risk of piracy, and in the interest of boat speed, they decided to take a hired hand along, ex-Special Forces, with a particularly violent background, much of it inscribed in scar tissue on his body. He was afraid of no one but nor did he trust anyone. He was a complete novice when it came to rowing a sculling boat but had navigated sections of the river often enough to be very familiar with its currents. In this manuscript, we will refer to him with the pseudonym Alvaro. While Anton and Mark

had never rowed the Amazon, they were experienced oarsmen. Anton is a rowing coach and boatman, Mark an organizational ethnographer whose fieldwork includes long stints with elite rowers and war surgical teams (Lok & de Rond, 2013; de Rond & Lok 2016). Both had rowed at club level since 2002.

The threesome set off in a leaky vessel, rowing in two hour shifts in daytime (three-hour shifts at night). Safety and boat speed remained priorities throughout, and served as heuristics in decision-making such that choosing between alternatives invariably meant to ask two questions: (1) Will it get us to our destination faster? and (2) Will it keep us safe? In the absence of certainties, the answers were framed in terms of relative probabilities. It soon became obvious that boat speed was directly contingent on water speed, such that rowing involved navigating the river in search for ever faster currents. Whether one had successfully “found” a faster current depended on the interplay of physical exertion and a GPS reading, or how hard one had to work to maintain a particular speed.

The oarsmen were required to check in with the Brazilian Navy at major cities along the route. During one of these compulsory stops in Manaus, Alvaro decided he had had enough and left Anton and Mark to continue the journey by themselves. What had been intended as an adventure for two ended just so, with two scrawny, sunburned, and somewhat bewildered oarsmen dragging a battered yellow boat into a dirty Macapá marina. By that time, they had nearly run out of fresh drinking water, damaged the rudder and lost two feet of keel. Their satellite phone had run out of units and, as they could not be replenished, stopped working. They had lost 30 kilograms between them, even when accounting for an abscess the size of a golf ball that required lancing mid-jungle for fear of septicemia. Anton, equipped with a surgical kit, courtesy of a medical student back home, had done the deed. As recorded in the field journal:

... and there really is very little else to say. We made our flight to Belem and onto Brasília and Sao Paulo. Neither of us had time for a shower and so we sat out the various plane rides in whatever piece of clothing seemed least offensive. I flew to Sao Paulo bare-chested, having not one clean shirt to my name. We were hungry and thirsty for beer or coke but anything cold would have done the trick. We were finally on our way home. We had lost thirty kilograms between us in body weight and were exhausted for not having slept more than three hours at a time for a month. Our egos were bruised as were our bodies and the minds that should have been quieted over the long row were noisier now than before we

began. Our souls never did get mended and so fuck the purging. Before we got depressed we were happy.

4.3.2 Data analysis

Ethnography involves the contextually rich description of the lives of others, or “the peculiar practice of representing the social reality of others through the analysis of one’s own experience in the world of these others” (Van Maanen, 2011, p. xiii). While distinctly old-fashioned, “fieldwork” affords a unique level of granularity, and therein lies its appeal. Its reliance on small samples poses challenges when drawing inferences as the basis for credible theoretical claims (Ketokivi & Mantere, 2010; Locke & Golden-Biddle, 1997). This process necessarily involves creating new and plausible connections between formal data, experience, a priori theory, and common sense (Langley, 1999, p. 707) during a series of iterations that force one to actively question emerging theorizations against field data and the ethnographer’s pre-understanding (Alvesson & Kärreman, 2007; Mantere & Ketokivi, 2013).

Our field data was derived from what Wacquant (2015) variously refers to as “enacted ethnography” or “carnal sociology”. This is a methodological approach not “of the body as sociocultural object but from the body” (Wacquant, 2015, p. 4; *italics ours*), meaning one “performs the phenomenon” of interest and analysis (Wacquant, 2015, p. 1). Wacquant demonstrated this approach by joining a south Chicago boxing gym so as to better appreciate the structure of its society through the art of pugilism (2011; 2004; 1995a; 1995b). He took to boxing, and it to him, such that, three years later, he narrowly missed out on winning a Golden Gloves tournament, and briefly considered trading his academic profession for that of the pugilist. His methodological approach is rooted in the belief that human beings are sentient. In other words, they are capable of feeling and conscious of those feelings, they suffer, and they are skilled. He argues that this ability to sense, suffer, and perform skilfully is sedimented, meaning that it is cultivated over time through engaging in the world, and situated in that these sediments themselves are “shaped by our unique location and peregrinations in physical and social space” (Wacquant, 2015, p. 3). It is only by exploring how these six elements work in concert through time and space – as a tangled dance of body, mind, activity, and world – that one “takes full epistemic advantage of the visceral nature of social life” (Wacquant, 2005, p. 446).

Taking our cue from Wacquant's methodological approach, one of us decided to fully participate in planning, preparing for, and executing the Amazon adventure. Mark was one of the original pair that set off from Nauta to arrive in Macapá one month later. His experiences and that of the other rowers were recorded on video, in photographs, in audio recordings, and in a field journal. In the interest of safeguarding critical distance, the video data were coded independently by one of the other two authors. The coded video segments were examined against field notes and audio files, the ethnographer's understanding and memory, and against an independent analysis of select video files by a third author. This process, while time-consuming, enabled us to retain a critical assessment of what the video data appeared to show that would subsequently be checked against the ethnographer's experience, field notes, and audio recordings. These iterations were helpful insofar as the other authors were able to spot social interactions that might well not have been remembered had they not been captured on video, while the ethnographer was able to provide the necessary context for the segment in question. He was also able to provide descriptions – from memory and the field journal – of physical sensations to accompany the footage.

The video segments broadly fall into two camps: “talking head” descriptions of what was going on at the time or what just happened and how the crew responded, and longer, real-time footage of the journey as it unfolded. In the latter kind of video there is little evidence of the crew playing to the camera insofar as the camera was used extensively, the feeling of fatigue rapidly became such that they no longer seemed to care whether the camera was on or off. Moreover, several “talking heads” segments included useful background talk that was recorded unbeknownst to those not facing the camera directly. Thus, one of the crew might be recording himself in the cabin while voices from those outside the cabin are still audible but without knowledge that their conversations were being recorded. Some of the rich detail of these videos is lost when we describe them textually; for this reason we have included links to some clips of video throughout the text. All of the linked data videos are available in one place at www.isaacholeman.org/dissertation.

4.4 Findings

4.4.1 The Skilled and Sensate Body

While much work on sensemaking foregrounds the bracketing and interpretation of experience that triggers (cognitive) sense being made, our analysis emphasizes that sensemaking relies on cues provided first and foremost by the sensate body, or “the way things feel.” The body and its senses are not merely the first waypoint on the journey to a cognitive understanding of the situation, but may be ongoingly implicated in how people grasp and navigate the (emergent) situation at hand.

In their first days on the water, the rowers worked out that average speeds of 6 miles per hour (MPH) by day and 4 MPH by night were feasible, and that a 24-hour rowing schedule based on these speeds would see them to their destination on time. This provisional understanding was made possible, in part, by a GPS device that logged current boat speed down to a tenth of a mile per hour. Readings of boat speed soon became integral to everyday work and talk on the boat. Boat speed could be used to take stock of the present situation, e.g. how’s it going? Not bad, we’re doing sevens (meaning roughly 7 MPH). It could be used to encourage or express aspirations for performance, e.g. right, let’s go spank out some sixes! (meaning let’s go row at 6+ MPH). In the way sensemaking is often talked about in the literature, arrival at and reliance at these boat speed heuristics could be taken as evidence that sense had been made.

However, heuristics related to average boat speed served merely as partial anchors of and guides to action that was in fact more complex and subtle in the face of actual shifting features of the river, the crew, and the boat. Head winds offset boat speed and gusts from one side pushed the boat off stream. Choppy water changed the oar’s purchase in the water, islands and side streams altered the current. Shortcuts cut across large bends in the river but would often pass through stagnant water. While the GPS had a small map, it did not account for the fact that flood waters constantly change the path and shape of the Amazon and its innumerable tributaries, islands and sandbanks. Bodies, too, changed hourly with the level of fatigue, state of hydration, exposure to the sun, rain or wind, and sensitivity of the back, hands, bottom or feet to the seat, oar handles, and foot plate of the boat. The boat itself lost part of its keel being pushed into the bank by a storm, and gained weight (and thus lost speed) with each stop for supplies.

Numerous leaks required the electric pump to run constantly, which in turn required attention to solar panels that malfunctioned on several occasions.

These complexities were ordinary on the river, with the result that boat speed was not a ‘ready to use’ index of their current situation. Rather, making sense of boat speed readings involved a certain kind of work. Their situated activity entailed judging boat speed in light of a holistic sense of the salient features of the situation, including their perception of local topography and how hard they had to work the oars to achieve or maintain a particular speed. Insofar as these other features of the situation were perceived through bodily senses, we might say that their sensemaking proceeded from the body.

The manner in which sensemaking proceeds from the body is particularly clear when we examine the practice of chasing currents. Chasing currents on the Amazon takes considerable skill because it is very difficult to see differences in the flow of water across such a large river. When the voyage began, Alvaro was new to sculling and his rowing technique was poor, but his familiarity with navigating the Amazon on a raft gave him superior insight into increasing boat speed by chasing currents. On day five, Mark placed a camera on a tripod to capture Anton and Alvaro rowing (See video at: <https://youtu.be/CdvAWauQJFg>). In the video, music plays in the background and, rather than interact with the camera, they row with few words. The ergonomic orientation of sculling is such that the rowers propel the boat in the direction to which their backs are turned, which means that they must look over their shoulders in order to see where they are going. About one minute into the video, Anton glances over his shoulder and says, “you trying to head out into it?”

Alvaro: “Yeah, just [inaudible over music, glances over shoulder and gestures to the direction they are rowing]. Let’s check it out.”

The two continue rowing for 70 seconds, during which time Anton makes a few comments about dolphins and Alvaro remains silent but briefly looks at the GPS six times. On the seventh occasion Alvaro’s gaze fixes on the GPS for nine seconds and then he glances over his shoulder to Anton, who is behind him, and says, “Look how fast it picked up.” As he says the words “picked up,” Alvaro gestures with his head back to the GPS. Alvaro then begins bobbing his head to the rock song just beginning to play

on their stereo in the background. Seven seconds later he shouts to no one in particular, “WE’RE BACK IN BUSINESS.” Six seconds later he stops rowing and turns around to offer Anton a high-five. Grinning widely (a rare occurrence for the typically stern Alvaro), he gestures with his hands to the GPS in a self-congratulatory mood.

In this episode, their efforts begin with felt experience and proceed in a manner that enables them to make sense of particular currents. Alvaro attends to their boat speed in light of how hard they are rowing and perhaps other sense perceptions. He feels that they could be moving faster, and without talking he begins to turn the boat perpendicular to their downstream course. Only after feeling Alvaro begin to turn the boat does Anton ask, “you trying to head out into it?”

Alvaro does not claim to know whether the current elsewhere will be swifter. He speculates, suggesting that they cannot know about the distant stretch of water until they “check it out,” i.e. until they feel the current quickening. While they row at a steady level of exertion, Alvaro checks the GPS frequently, with greater concentration than was typical of rowing in general. This implies that Alvaro anticipates or hopes that boat speed will soon increase, but he does not know whether, or perhaps more precisely, where this might occur. Not until he observes the GPS readings gradually increasing does he sense that they have apprehended a swifter current. This was not a purely visual perception, however, because it relied on the feeling that they were rowing at a steady level of exertion and other contextual details. His celebration highlights that he appreciates an outcome that was not pre-ordained and which he attributes to his skill at the craft of chasing currents.

Repeated experiences like this led Mark to an epiphany by the end of the third day on the water. In a video journal from the boat’s cabin, he reflected:

We were just so exhausted, we didn’t get very much sleep. So what we’ve done instead is just to accept that you don’t really row the Amazon. It’s interesting. You don’t attack the Amazon; it’s too powerful. So what you do is ride it, and let it take you where you want to go. So the emphasis now is not on rowing as hard as we can. The emphasis is really on finding the fastest current and chasing it. This is also where Alvaro comes in quite handily; he’s very good at reading rivers. And that’s something that Anton and I are learning to do as well. It makes the rowing lighter, it allows us to get a bit more sleep and makes the experience a little bit more pleasant than the misery it can be if you don’t get enough sleep (See video at: <https://youtu.be/gNIO943XYNY>).

Yet this particular insight could not in any standalone manner render a complex situation sensible. In a telling episode the following day, Mark experiences a sense of dissonance about the boat's progress. He feels it through his body as he struggles to keep the boat on course and works to grasp what is driving them astray.

On day four in the water, they turned a camera on, placed it in a corner of the cabin, and ignored it for just over an hour. Fifty-two minutes into the original video, Alvaro is lying on his back inside the cabin and Anton stands just outside of it (See video at: <https://youtu.be/YG4yonBgUWk>). They are animatedly discussing the possibility of future boat races on the Amazon when Mark, off-camera and apparently in the rowing seat, interjects:

Mark: Does it matter which side I'm on Alvaro, or not?

Alvaro: Which what?

Mark: Does it matter which side of the river I'm on?

Alvaro: Yeah, look for the one has the stronger current.

Mark: What?

Anton relaying to Mark: Find the current.

Mark: Okay, that's fine. That's what I'm trying to do but it gets, I get pulled in this direction, so...

Anton: Right, I'm gonna have a quick shower, then we'll talk. Cause this is gonna be worth talking about.

This comment is addressed to Alvaro and refers to the discussion of future boat races rather than to Mark's present rowing challenges. After this, the camera stays pointed at Alvaro inside the cabin. While this video does not show Mark struggling it is methodologically useful that the camera has caught this scene unintentionally. It is a highly candid and real-time document of Mark's difficulty. Outside the cabin Anton showers and continues to discuss future boat races with Alvaro until Mark interjects again, inaudible over Anton's shower, and Anton responds. Fifty-seven minutes into the video:

Anton: Where you trying to go?

Mark: I'm trying to go back, but whatever. I can't row when I'm pulled to the side. The rudder is always pulling [can't hear]... it's almost like a whirlpool but I can't see one....

Anton: You realize it's pulling you back if you try to turn that way.

Mark: Yeah.

Anton: If you pull... you're trying to turn that way.

Mark: Thank you.

Anton: I think use the oars or use the rudder, but if you use both, it gets... there you go.
Mark: [sounding frustrated] Alright. I'm going to try to get back to where we were, out of this sideways pool. Otherwise it feels impossible.
Alvaro: [commanding tone] Avoid [then opens cabin door before repeating], avoid like a bay on this side here [points].
Anton relays to Mark: [matter of fact tone] Avoid this bay. Right, back over. You're on the right side.
Alvaro: Avoid a bay. Looks like is a...
Mark: Where do I need to go?
Alvaro: Straight.
Anton to Mark: Go straight for that corner. [then louder, to Alvaro in the cabin] Is it a meander left?
Alvaro: Let me see [shifts position, gets up] ah...
Anton: [again matter of fact] Just cut that whole corner. He's saying this bay is low [i.e. shallow].
Alvaro: [sounding decisive] Yep, yeah straight there.
Mark: [sounding defeated] Because the boat keeps me pulled to the left and I feel like a whirlpool getting turned around.

In this vignette, Mark first and foremost feels that the boat is moving poorly for being pulled to one side by a whirlpool that he cannot see. The steady rowing techniques that would correct a boat's course in calm water have been tried here and found wanting. At this point in the journey the importance of chasing currents has been articulated explicitly in words and he knows their heuristics for good day-time boat speed. Still, having made explicit sense of the situation in this general manner is of little use in navigating the particularities of the challenge at hand, which must be perceived as a body in contact with the current through the oars and through the rowing seat which is fixed to the hull.

When asking whether he should chase a current across the river does not clarify these ambiguities, he tries another line of inquiry. Perhaps, he suggests to Anton, the whirlpool feeling is an equipment issue that has to do with the rudder. Anton, whose expertise as a rowing coach lies in rowing technique and boat equipment, demonstrates use of the rudder and proposes that it may be simpler to use either the oars or the rudder, but not both at the same time. Mark thanks him, but still feels dissonance about the sideways pull and the whirlpool feeling. Then Alvaro attributes the sideways pull to a bay, knowing that water through a bay may be shallower and will not necessarily flow directly downstream, and he tells them to cut out of it. This comment is helpful; it makes

sense as a response to Mark's felt experience of struggling with this strange current. As a group their sensemaking has involved talking, yet bodily sense perceptions clearly came prior to articulable understandings as a springboard for sensible action.

At this stage in the journey, Mark and Anton have made sense of their new orientation to chasing currents rather than "muscling through." Moreover, they are sensitive enough to notice when a situation has become problematic; they allow themselves to feel disoriented in currents of poor or strange quality. However, they still stumble over producing working interpretations of these feelings with enough clarity or confidence to weigh the merits of staying the present course against the merits of seeking uncertain currents in another stretch of river. They have 'wrapped their heads around' what it means to chase currents, yet their confrontations with particular currents still cause real experiences of disorientation and struggle. The researcher who treats 'sense' as a conclusion in the process may remark that they have 'acted their way into sense,' yet the researcher who foregrounds ongoing practice will note that they still struggle to sense their way into action.

4.4.2 Enacting a Sensible Environment

It would be impossible to explain the difficulty of sensing their way into action without attending to the emergent complexities of the continually changing environment they faced on the river. Each current and bend in the river was complex or unique enough to merit further touching, feeling, sensing the way forward. Yet their manner of sensing these complexities was substantially of their own making; the bodily craft of rowing involved their boat, oars, GPS, maps, the other tools of their work and a practical way of orienting to currents. Sensemaking scholars have long used the term enactment to convey that "in organizational life, people often produce part of the environment they face" (Weick, 1995, p. 30). Yet most of the recent literature depicts this process of enactment as largely intangible, a shift in perspective that seems more or less synonymous with cognitive bracketing. This reduces "enacting a sensible environment" to a largely mental or social process of construction. As a result it does little to elucidate the tactile work and concrete material reconfigurations that were vital to the process of sensemaking in our case.

Consider for example the scene above in which Alvaro and Anton “head out into it,” chasing a faster current. The video shows Alvaro’s attentive gaze fix repeatedly on the GPS device, yet it is probably not the device itself which has his attention here. More likely the GPS has become transparent to him as he attends to the current. When Alvaro says to Anton “look how fast it picked up” and gestures to the GPS device, the it he refers to is not the number on the screen but the current itself, which is readily perceived by way of the technology’s reading of boat speed. Alvaro does not mention the number and it probably does not matter whether it is historically high or historically middling. What is meaningful or what makes sense in this particular situation is that boat speed is noticeably swifter than it was moments before in a different piece of water. Like the blind man’s cane, the GPS is no longer an object he attends to so much as an integral part of his practice of perception. Had the GPS device broken down, they would have experienced an acute sense of disorientation and pressure to discover new ways of making sense of currents.

In fact, just such a material break down did begin to occur less than a week into their journey. At their point of departure Mark and Anton had the callused hands and strong backs of experienced oarsmen; Alvaro did not. His hands fared poorly under the abrasive strain of a relentless day-and-night rowing schedule. As is evident from Image 4.1, they began to fall apart, as did his heels where they rubbed at the shoe line.

Figure 4.1: Screenshot from a video of Alvaro taping his hands



Mark and Anton did not suffer similarly, and in videos Alvaro puzzles over whether some change in grip or rowing technique might preserve his hands. On their third day

on the river Alvaro asks, “what do you do about blisters?” Anton’s brusque response was, “man up!” Whatever he makes of Anton’s advice, Alvaro also tools up; by the following day we see him wearing gloves and guarding his hands with athletic tape in no less than nine places, while Anton laughs that he’s “never seen anything like it”.

Competence in many tasks begins with the hands and relies on a physiological process of sensorimotor development and callus formation. Daily taping did not eliminate pain but it was a practical way of accommodating material break down. Over time new calluses formed on Alvaro’s hands. He did not need to tape as much and his hands became more sensate, more capable of making sense of the current than when blisters had rendered his hands too painfully sensitive for that task. The significance of material break down was readily apparent to the practitioner in the thick of action: Alvaro’s hands were vital not only as one of the boat’s “engines” or sources of power, but also because they were integral to his way of chasing and making sense of particular currents. If a new practice for maintaining the hands had not materialized, his skill in making sense of new currents would have foundered, at least until his hands formed new calluses. To account for the significance of material break down, our analysis of this case led us to recast ‘enacting a sensible environment’ as an emergent sociomaterial enactment rather than a largely mental affair.

When we take this view of how sensemaking is situated in the material world, a variety of practical problem solving activities are cast in a new light, as related to and sometimes essential for ongoing practices of sensemaking. For example, the rowers’ skin was also threatened by the sun, which was easily hot enough to raise blisters. In a private video journal during their fourth day on the water, Anton reflects:

I've been rowing all day in the blistering heat, praying for rain. I've come off about 30 minutes ago, my face feels on fire, burning to pieces. Back's killing me, and the heaven's opened! It's absolutely chucking it down [raining] now, and the guys are loving it. They've taken to sloshing themselves down with water during the day while they're rowing, which is all well and good, but I have pointed out that they've got a really bad chance of, they've got water loitering around down there at the crack of their rear, that there's a good chance they'll get a massive blister there. Which I think Alvaro's already got, to be honest with you. And Mark will catch him up at this rate. But, still, that's what we've got the nappy cream for (See video at: <https://youtu.be/IUUX6Y0iKZU>).

Over the course of several weeks Mark and Alvaro both developed painful cases of “nappy rash,” and only then stopped dousing themselves in water. Given the extreme humidity and sweat of hard rowing, they additionally took to laying out clothes to dry in the sun and applying talcum powder to dry their skin. Both activities had unintended consequences: gusts of wind would occasionally blow clothes off into the water and by the end of the month they scarcely had enough changes of clothing remaining to stay hygienic and dry. For some time the sun’s heat seemed unrelated to the fact that their solar panel batteries were gradually ceasing to hold a charge. Eventually they discovered that in coating their bodies in talcum powder, they were inadvertently coating the panels as well, reducing their efficacy by roughly a third.

Towards the end of their journey an abscess formed on Mark’s posterior as a result of prolonged wetness and skin rash. A gripping video shows Anton performing a small field surgery, without anaesthetic, to drain the abscess. While visibly excruciating, this amateur procedure clearly made sense given the circumstances. The most sensible way to afford progress was to drain the abscess and cut a large hole in Mark’s rowing seat to accommodate the wound. Failing to accommodate this material break down would not merely have disrupted their ability to muscle through. As with Alvaro’s blisters, it would have disrupted Mark’s participation in the ongoing work of making sense of and chasing particular new currents. Through this visceral experience Mark also made new sense of his prior habit of dousing himself in water. In such hot weather Anton’s initial warnings about staying dry apparently made little sense to Mark and Alvaro. In retrospect, Mark made sense of the fact that his habit of dousing had been regrettable, even dangerous.

In this way hot weather led to dousing which caused skin damage and laborious skin care practices of drying and powdering, followed by the routine cleaning of solar panels, an unwelcome field surgery and corresponding modifications to rowing equipment. The unexpected turns of this process began with the situated activity of rowing and making sense of particular currents, encounters with material break down or resistance to their initial ways of working, and practical responses to this break down. Practice break downs can be disorienting; they led the rowers to explore puzzling cues about the material origins of their concrete difficulties. Courses of action that had once seemed sensible gained new meaning in retrospect, some even seemed foolish in light of subsequent experiences, and they established a new way of responding to moisture on

their bodies. Their new practices reflected their emergent sense of the material realities, including some unexpected and some proactive changes to the material environment itself—the ontological form of their hands, skin and tools. Such material reconfigurations did not first and foremost happen to them; they were at least in part enacted by them. Through the emergence of these new sociomaterial practices, they were enacting a sensible environment and a sensible way forward.

If the study of sensemaking is to be a study of activities that result in a stable corpus of shared meanings, practices of body and tool maintenance and repair may well seem tangential. Yet as we argued in the previous section, their relatively stable sense of currents in general was often insufficient for them to sense their way into action, and thus documenting how they made sense of the particulars of each new current became more important. As a consequence of this first insight, concrete material breakdowns in the practices through which they ongoingly made sense of new currents also came to matter. When we study sensemaking in terms of how people explore, interpret and respond to whether practical actions make sense in relation to the particularities of concrete situations, the work of sensemaking is clearly situated in the material world. In the following section we will show that such ongoing activities often draw on the meanings generated on prior occasions, and in so doing hold the potential to remake and transform them.

4.4.3 Sensemaking is an Ongoing Accomplishment

Our third finding emphasizes that sensemaking is best understood as an ongoing activity through which people generate provisional sense of situations that are unfolding moment by moment. While sensemaking is ongoing was one of Weick's seven principles of sensemaking, Sandberg and Tsoukas argue convincingly that in recent organizational literature, "sensemaking is confined to specific episodes (in which some organizational activities are interrupted until they are satisfactorily restored)" (2015, p. 26). Since such disruptive episodes are exceptions to the norm, the implication is that sense is normally relatively stable and can be unproblematically 'applied' in routine organizing. This stability paradigm is clear for example when people are said to produce a sort of "meaning that they hope is stable enough for them to act into the future, continue to

act, and to have the sense that they remain in touch with the continuing flow of experience" (Weick, 2005, p. 410).

To investigate the relative stability or provisionality of sense, and the concomitant episodic or ongoing character or sensemaking activities, we explored situations in which it could appear as if sense were being unproblematically ‘applied’ to new situations. In the following paragraphs, we use three disparate cases to empirically re-specify what it takes to ‘apply’ sense in situations that are always changing, showing that it involves a particular kind of activity. Building on our first two findings, we show that this activity cannot be fully divorced from skilled bodily conduct in material situations that are subject to ongoing change. While a repertoire of examples, heuristics or actions may be drawn from prior experience, applying them to new situations typically involves reworking them. That is to say, bringing skills, habits and prior perceptions to bear on new situations often involves making sense anew. In this way, we argue that ‘sense’ is typically as situated and provisional as the action it concerns, and thus that sensemaking is an ongoing accomplishment.

The manner in which sense is made and remade for each new moment is clear when we consider, for example, how the rowers made sense of a growing tidal current towards the end of their journey. For over three weeks they had zigzagged across a growing river, staying true to their sense that chasing currents was more fruitful than muscling through. However, in the final week of their journey, chasing currents became increasingly difficult. Rowing sideways across a river that had grown kilometres wide was not always worthwhile, and currents were increasingly less visible. Wind and choppy water sometimes played a greater role, relative to current, than it had on a smaller and calmer river. Less than a week before the end of their journey, Anton remarked:

We are getting heavily crucified by the wind today. The reality of it is, we shouldn't be rowing. We should not be rowing at all, it's too dangerous, we can't control the boat. But our survival instinct, our pure drive is making us want to carry on. We might only be ticking over at 3 1/2 or 4 km per hour, but we're ticking over, we're still moving forward. We're not so much rowing with the stream as just sat on it, trying to keep the boat pointing in the right direction (See video at: <https://youtu.be/9JEZ2fCHZZI>).

At this point they shifted the rowing schedule to prioritize rowing together rather than in turns because they were struggling against wind, choppy water and fatigue to

keep the boat pointed in the right direction. These later videos are striking for the palpable tone of exhaustion, which was visible in their postures even when they remained silent. Increasingly anxious about arriving in time for their planned celebration party and flight back home, they kept a desperate pace that overtaxed their bodies, taking morphine-based pain killers to relieve aching backs. They had begun using kilometres rather than miles, simply because the shorter unit made them feel as though they were making greater progress. Four days before the end of the journey, Mark described the situation as “very, very tough, morally very, very tough, and also physically, Anton and I are very, very tired”. Eventually their struggle became so severe, the current so elusive, that they reverted from chasing currents back to muscling through:

Anton: The wind's picked up again... and it kills you. It actually kills you. But we've got ourselves in a position on the river where we're actually achieving over 4.5 km per hour resting [Anton places GPS screen in front of camera for evidence]. So, what do we do? There's a couple of choices: We either get out there and make the most of it, or we recover. Bear in mind we're both exhausted... Mark's actually got physical injuries, my back's killing me. The boat's just so up and down, all over the place... Why kill ourselves now when we can relax? Why not kill ourselves when we're not making the distance? So we are. The new plan is Mark and I just row together. If we find this stream, we row apart, fine no problem at all. But we row together and we make distance. That is it, that's our only goal (See video at: <https://youtu.be/9R7iJfPCAj4>).

This is one of several videos in which they reported finding very swift currents amidst what otherwise had become a gruelling stretch of river. Resting through swift water was a departure from their prior practice of chasing currents, but Anton's remarks were not as paradoxical as they initially may seem. The river had grown to nearly twenty miles wide and swift currents had become elusive to a point that chasing them was no longer a viable strategy. Muscling through was their only option most of the time, and given their exhaustion, resting when the current was in their favour seemed sensible enough. In other words, they knew that currents were still out there but their old ways of finding them no longer made sense, and as a result they reverted to muscling through.

Just over twenty-four hours before the end of their journey, they passed through a series of islands on very swift current and then seemed to hit an invisible wall. They were making so little progress—just 1.5 or 2 km per hour—while rowing so hard that

they began to feel as if they were rowing against the current. Following this perception, their first on-the-spot experiment was to stop rowing altogether—the GPS seemed to indicate that they were drifting backwards! Moments later they had rowed close enough to the bank to put down anchor and they turned on the camera, speculating that they were now close enough to the ocean to have entered a tidal zone. This was not initially obvious because they were still over 100 km from the ocean. Unlike a large whirlpool which may affect one part of the river, a tidal current would drive the whole river backward or speed its flowing forward depending on the time of day. They tried throwing bits of tissue into the water to see if they drifted backwards. They discussed waiting for the tidal current to change to see if their boat swung around the anchor. They also used the satellite phone to ask friends to search online for information about how far up-river the tidal zone extends. The answer came back while the camera was still rolling and Mark reported to Anton:

She says here the tide affects much beyond 100k in. So I think we've already felt the effects, but we haven't realized what the effects were. Now we're actually feeling more and more strongly, and the effect is going to be more and more distinctive (See video at: <https://youtu.be/yefEbEcIjF8>).

When Mark says that they have “already felt the effects,” he is doing something more than accepting the phone message at face value. He is also reflecting on their recent experiences with stretches of gruelling work and other periods of inexplicably fast water. He is recognizing that they had been feeling the tidal current for some time, but had not been feeling it as a current. New information helped Mark to articulate a new sense of the situation, but they only took action to seek out new information after an initial perception, a matter of felt experience. That is to say, their making sense of the tidal current involved first feeling the slow water as a current.

In some obvious respects this is a classic case of a small team making sense of a highly disorienting episode. It exhibits the dense ambiguity and complex temporal loops of noticing, interpretation and action that have long intrigued sensemaking scholars. We discuss it at some length for several reasons. First, it clearly involves bringing prior experience to bear on a new and evolving situation, in some manner ‘applying’ the sense they had generated on prior occasions. Beginning to feel as though they were rowing against a current was only possible because of their prior exposure to currents. This

perception may even have hinged on the particular manner that the ongoing practice of chasing currents had attuned them to the felt experience of poor current. Moreover, their general sense of the importance of chasing currents was just as applicable after this episode as it had been before. Once they finally perceived the tidal current, their prior sense of chasing currents laid plain what should be done to chase the tide.

Second, this case shows that bringing their prior sense of chasing currents to bear on a fluid situation involved making sense anew. The fact that they had actually felt the tidal current for days, before making sense of it as a current, shows that their prior sense of chasing currents could not be unproblematically applied to an evolving situation. The actual practice of chasing currents had engendered further sensemaking because the nature and qualities of the currents had changed. This draws attention to our third reason for exploring this case: it foregrounds the central role of the sensate body in contact with the materials of a concrete situation. These are the means with which we perceive how our circumstances are changing and whether our prior ways of working still make sense. Their rowing had become remarkably difficult but they did not begin to consciously think of themselves as having been disoriented until after they felt as though they were rowing against a current. We do not ‘apply’ the bodily senses and investigate the material world after mentally registering disorienting cues. Rather, we are always already entangled in concrete practices; these practices are resources for the ongoing accomplishment of sensible action but do not in any strong sense determine its course.

Our final reason for exploring how initially imperceptible changes in the current engendered an obvious case of sensemaking is that it raises questions about whether other, more frequent changes in the current may also have engendered sensemaking. In particular, we are interested in cases where sensemaking was less obvious and memorable, but no less important to the success of their journey. Consider for example a video that shows Anton rowing near the edge of the river, in which his ongoing sensemaking is relatively more implicit:

Anton: There's not a lot of current here at the moment, just over two miles an hour. The river's not massive here, but the only place there is a bit of current is right at the edge, so we've come chasing it. The problem is you get loads of trees kind of sticking out of the water, dead branches and trees (See video at: <https://youtu.be/PylZMwzfqqY>).

In this scene, Anton observes that the river is “not massive” and that two miles per hour is “not a lot of current.” These are both relational observations. He is seeing their present stretch of water as slower and less massive than other stretches of the Amazon with which he is familiar (it certainly is massive in relation to the canals he typically rows back in England). We need not assume that he has made these observations by calling up mental images of other places and making point by point comparisons. More likely his perception precedes any conscious or line-item manner of retrospection. His perception that this is “not a lot of current” precedes his saying ‘a lot in comparison with what?’ Anton’s familiarity and competency for skilled action in this general type of current means that he does not experience the disorientation and breakdown of practice that we typically associate with more acute moments for sensemaking.

At the same time, they are close enough to the bank to puncture the boat if they grow inattentive. In fact, Anton seems to be testing the edge at which the danger of debris outweighs the merit of a swifter current, an edge that curves as the boat glides around each bend in the river. This edge holds to the contours of the bank; it sways with the flow of innumerable tributaries, the presence of islands and sandbanks that change locations during seasonal floods. It becomes less perceptible in the dark; the rowers often “play it safe” at night or when they are tired. After several weeks of rowing these situational novelties have become familiar, even mundane, but ordinary novelties still require sensemaking.³⁵ They are acutely aware that to perform competently in a flowing situation involves continuously sensing local cues, interpreting the stream of experience in light of a repertoire of past performances and taking action accordingly. And yet they seldom reflect consciously on the challenges of sensemaking unless the work proceeds less masterfully. Thus it is only through real time observation and participation in the work itself that we, as researchers, can readily perceive the extent to which finding a sensible path down the river is an ongoing accomplishment.

³⁵ We use the term ‘ordinary’ to describe some parts of the rowers’ lived experience. Making sense of this kind of current came to feel ordinary, in the context of rowing the Amazon, because they did so thousands of times over the course of their journey. To observe that sensemaking occurs even in situations that feel ordinary to the people involved is an entirely different point than to make the equally true observation that rowing the Amazon is an extreme case, and in that sense not an ordinary scene in relation to other organizational research.

These two cases are drawn from relatively similar situations of practice: chasing various kinds of currents on the Amazon river. Taken together, they illustrate that making sense of each substantially novel current is an ongoing accomplishment. If we are to take this ongoing work seriously, it is important to recognize not only the difficulty of relating seemingly similar situations of practice, but also the ease with which people occasionally relate remarkably different practices. For example, piracy was a constant concern and some stretches of their journey they knew to be particularly dangerous. At the same time, they did not see any clear evidence of pirates and were not inclined to stop their journey on the basis of troubling news reports and local hearsay alone.

Anton: There's a lot of opinion about the dangers of the Amazon within ourselves. We're not taking unnecessary risks, if we feel that someone is telling us that there is a danger, and people don't say these things for no reason.

Alvaro interjects from off camera: "Don't take the shortcuts," we still take it.

Anton: Yeah, [turns back to face camera] we were told not to take the short cuts but we still took it because we saw other boats going through so we knew it would be safe because there were people about. Or... that it would be more safe that way. So, what do you do? Do you kind of hide in your bedroom under the bed all day, or do you get out there and have a look around?... I don't think anyone should take a candid approach to it and just try and steamroll through. You need to speak to the people that are offering you help... but when you hear about people with semi-automatic rifles shooting at you from people that have done stuff like this before, you wonder how much of it is actually exaggerated.

In this scene, they are making sense of the advice about pirates as similar in kind to the advice they received about not taking short cuts. The reference to taking shortcuts calls up a nuanced and practical way forward. In the past they have mostly ignored such warnings, though the reference also invokes memories of particular short cuts that went poorly. For example, we have videos of the rowers “breaking their backs” to get through a tiny channel of still water—a shortcut that turned out to be shallower than they had hoped. The rower who recalls that felt experience will grasp the meaning of the reference in a particular way, differently than an unpractised rower. Anton saying “or do you get out there and have a look around?” can only be well understood in light of how they have previously discussed “doing their homework” to investigate particular shortcuts. The extended practice of investigating shortcuts involved puzzling over maps, discussing the shape of the bank and whether a substantial portion of the river seemed to be flowing through the channel, and rowing closer to get a better view of boats that

may be going into or out of the potential shortcut (See this chapter's appendix for a transcript and video at: https://youtu.be/___tBGfLJ7uM).

Key similarities between shortcuts and piracy risks will be expressible in a general principle, but this principle is not what has occurred to Alvaro and Anton. We find no evidence to suggest that they are consciously characterizing points of similarity or measuring the degree to which the reference to shortcuts is salient, in a general or timeless sense. Nor is there cause to suggest that their seeing piracy as similar to shortcuts will inevitably lead to a stable conclusion, resulting in unambiguous, shared interpretations. They still very much doubt their working interpretation; they are aware that they may have made a dangerous false equivalence. It would be more accurate to say that they currently feel impelled to respond to piracy issues in a manner that bears a practical resemblance to how they have responded to shortcuts. In light of this nebulous feeling, to say that 'we see the warnings about piracy as kind of like the warnings about shortcuts' is intelligible and full of meaning. As a practical perception it serves their purposes well enough for now. Until they acquire new information or discover an alternative way of dealing practically with piracy risks, this way forward makes sense. Their seeing-as does not halt their sensemaking any more than it brings the practice of rowing to a close. It advances their work for now, and their sensemaking continues as an active, ongoing accomplishment.

4.5 Discussion

Our three interrelated findings sketch an up close, real time and tactile notion of sensemaking. We call this perspective sensemaking in the flesh. We use this phrase to suggest physical presence as well as a connotation of contact and materiality that transcends human bodies—to flesh out is to add substance. In the flesh also suggests studying sense and sensemaking activities at their point of production. In emphasizing tacit bodily skills that are highly situated and provisional, we have not discovered a novel kind of sensemaking so much as drawn attention to themes that have been neglected in prior research. In the following section, we elaborate on our findings by relating them to theories of practice discussed in organization studies and more broadly. Thereafter we will return to the sensemaking literature, exploring the implications of our work for future studies of sensemaking in organizations.

4.5.1 Situating meaning in concrete practices

Suchman's (2006) notion of situated action bears some obvious similarities to the pragmatism and phenomenological perspectives that have occasionally influenced sensemaking research, in that they are all well understood as theories of practice. Attempts to form a unified, systematic or integrated "practice theory" have "largely given way to the suggestion that the concept of practice is most effectively used as a way of framing and orienting research" (Orlikowski & Scott, 2008, p. 462). Thus in the spirit of what Nicolini (2012, p. 213-215) has called the programmatic eclecticism of the practice turn, we review several themes in practice theorizing that may support further reflection on our case and be used to frame future studies of sensemaking.

Much contemporary practice theorizing takes influence from Wittgenstein's writing about how mental reasoning and formal knowledge differ from 'knowing how to go on' in ways that make practical sense. In a well known passage in *Philosophical Investigations*, Wittgenstein (2010) discusses what happens when someone watches another person write down a series of numbers and suddenly grasps how to continue the series: "now I can go on!" The principle behind the series of numbers will be expressible in a formula, but this formula is not what the observer initially has perceived. According to Wittgenstein, being able to demonstrate the next step in a continuing pattern is not a mental process in the sense that it does not necessarily involve consciously thinking of the formula, the timeless mental content 'behind' or 'within' the act of writing down a series of numbers. Moreover, when a student has memorized the formula but cannot independently write down the series of numbers that should follow from it, they would not be taken, for practical purposes, to have grasped the meaning of the formula.

Wittgenstein's observations resonate with our empirical case in important respects. When Mark had made general sense of the key principle behind chasing currents, but failed to grasp a sensible way forward in the face of an odd whirlpool feeling, his circumstance was not unlike the mathematics student who has memorized the formula but cannot work out how to write down the ongoing series of numbers. In the third section of our findings when Anton 'chases the edge' he is demonstrating an ability to go on sensibly; it is the performance itself that makes sense. He reflects on having come to chase the current in spite of the debris, yet these conscious reflections are not nuanced enough to independently explain his skilful conduct in tracking the edge. In this view,

making sense of a series of numbers, a novel situation or a concrete practice involves being able to continue on from it, of grasping a sensible way forward.

Building on Wittgenstein's thinking, Williams (2014, p. 71) offers a compelling example from the arts:

Many years ago, I heard a distinguished sculptor saying that he had discovered his vocation when visiting a gallery in his teens. "I knew," he said, "that there was something missing from that gallery, and it was my work." The gallery had been showing a set of exhibition pieces designed to lead up to the work of Rodin; the teenage visitor had sensed that he knew how to go on from Rodin, so that his work would be the obvious next step in a story. You could say that he did not 'agree' that Rodin should be where the story ended; but that does not add up to a rejection of Rodin, and that indeed was as far as possible from the younger man's intention. In his own terms, he had understood Rodin better than anyone who simply looked at Rodin as a phenomenon without any conviction that this was a story in which s/he belonged; sensing a pressure to respond and continue is the mark of understanding what is perceived in this context, not least because sensing such a pressure implies apprehending what is before you as in some sense an address and invitation.

In this view, sensing a pressure to respond in a particular manner to a novel situation is a practical indicator of what we take to be intelligible or meaningful about that situation. The sculptor's experience is striking because his making sense of what to do next is so strongly oriented to ongoing activity that forming a stable interpretation of Rodin's work was almost beside the point. This orientation presents a stark contrast with the many art critics whom have interpreted Rodin's work without accomplishing any lucid or compelling sense for how to go on from Rodin. In line with our third finding Williams later adds, "this whole argument assumes that encounters with our environment are not exclusively or even primarily exercises in gathering evidence that will lead to a conclusion" (2014, p. 111). This temporal orientation to what makes sense provisionally as situations evolve is an important aspect of what some have called the logic of practice or practical rationality (Sandberg & Tsoukas, 2011).

As we analysed our data, insights concerning the provisional character of sensemaking followed closely from our attention to the sensate body and the situatedness of bodily conduct in the material world. A flowing stream is always novel and the rowers were perpetually making sense of how to deal with the next bend in the river. Their sensemaking was less visible when they did not experience acute breakdown or interruption of their practice, but this is not to say that sensemaking had in such cases

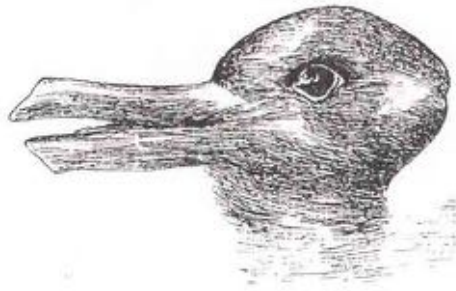
concluded. Fluid and rapidly changing situations do not afford substantive opportunities for sense to become explicit and stable, float to the top of the body, lodge in the brain and from that vantage shape or determine courses of action. Nonetheless, as our analysis proceeded we became aware that some readers might consider our findings regarding the body or material environment as relevant only to the first ‘stage’ of sensemaking, e.g. as the apparatus of ‘noticing.’ To develop a more encompassing view of bodily skill in perception and ongoing action in a material world, some discussion of the work of Merleau-Ponty (Merleau-Ponty & Smith, 1996) may be helpful.

Merleau-Ponty builds extensively on Heidegger and Wittgenstein’s thinking and, as Nicolini (2014, p. 56) and Crossley (2001) observe, his view of bodily habits resonates in broad themes with the later scholarship of Bourdieu (1977) and other practice theorists. In Merleau-Ponty’s analysis, perception occurs in the world rather than in the mind. That is to say, perceptions emerge from behaviours or practices that involve looking, listening, touching etc. Habitual practices build on deeply ingrained bodily skills:

Habit is neither a form of knowledge nor an involuntary action... it is knowledge in the hand, which is forthcoming only when bodily effort, is made, and cannot be formulated in detachment of that effort. The subject knows where the letters are on the typewriter as we know where one of our limbs are, through knowledge bred of familiarity which doesn’t give us a position in objective space (Merleau-Ponty, 1962, p. 144 quoted in Crossley, 1995).

In this view, use of the physical senses to notice external cues cannot be divorced from a mental act of interpretation because noticing and interpretation are at once and ambiguously involved in our bodily habits of perception. Wittgenstein makes a similar point with his now famous duck/rabbit image. At first we may see the image as a duck, and yet with a slightly different gaze, we may also see this image as a rabbit. What we notice depends on how we organize our visual field. Like the duck image, the rabbit image appears at once to us as a gestalt whole, not as an elongated ear, an eye and various other elements to be recognized individually before consciously working out that they form the figure of a rabbit. Perceiving the duck image as a rabbit involves an act of interpretation which is not separate from the bodily effort of looking attentively. Wittgenstein calls this instantaneous experience seeing-as or aspect perception, observing that it involves “the lighting up of an aspect” of what we are seeing.

Figure 4.2: Wittgenstein's gestalt duck-rabbit



Where Merleau-Ponty departs from and extends Wittgenstein's work is in his acute attention to bodily experience. In his words, "the subject does not weld together individual movements and individual stimuli but acquires the power to respond with a certain type of solution to a situation of a general form." Seeing this situation as similar to something in our experience is not the end of the process; we have not truly made sense of a situation until we have manifested the power to respond. This is not a matter of interpretations or intentions to respond in a particular way, but rather of actual conduct, of concrete bodily performance.

Our example of Mark feeling disoriented by the whirlpool illustrates this clearly. It would be unhelpful to insist that Mark had made sense of currents but failed to 'apply' his sense properly in this case. Rather, Mark was struggling to make sense of this particular current insofar as he initially lacked the power to respond to his perceptions in a sensible way. He was unable to make sense of the cues his senses had noticed. This is not to say that such bodily skill proceeds without the central nervous system, for brain/body separation is one of the dualisms that our analysis attempts to transcend. Rather, our purpose is to acknowledge the significance of tacit bodily skills which do not operate exclusively by way of conscious thought or in reference to explicit meanings.

The question of how the body's skilled sense of one situation may be realized as the power to respond in a novel situation is our concern in the case of feeling the incoming tide as a tidal current. The rowers' feeling-as involved noticing the current and in some sense interpreting or perceiving it differently than they had before. These were not two steps but aspects of a single experience organized by deeply ingrained habits of perception. Their habits of perception were in formation throughout their journey, trained through their repeated efforts to make sense of various kinds of currents. The

outside observer might well say that they initially had generated a sense (mental or otherwise) of how to chase currents, and later discovered that they could ‘apply’ this sense to the tidal current. Yet the real test of whether the tidal pull could be unproblematically treated as a current was their experience of difficulty and their lack of deftness in their initial responses to the tidal water. Similarly, in the case of relating advice about piracy to advice about shortcuts, it was not necessary that the cases bear a high degree of conceptual resemblance, for what mattered is that they exhibited an adroit power to respond in a way that made sense at the time.

To build on Merleau-Ponty’s typewriter example, consider that the hands have a sense of the locations of the keys. Our power to respond in this situation is exhibited in the way that we type without looking at the keyboard and our conscious attention to the words we are typing rather than to each individual letter. If we have practiced on a North American keyboard, our hands may well bring a general sense of keyboards to bear on their first encounter with a European keyboard. And yet the slightly different shape and location of the Enter key can be disorienting, for some disrupting the flow of typing again and again. To say after each missed stroke that we had ‘forgotten’ we were typing on a European keyboard would only be partially true. It would be more accurate to say that the hands do not forget, remember or think in the same manner as the conscious subject. They can only make sense of the new keyboard through repetitive practice, as a body in contact with the material world, that is to say in the flesh. It is for this reason that Merleau-Ponty writes not only of “the flesh of the body,” but also our inevitable contact with “the flesh of the world.” In this manner even activities as cerebral as writing scholarly manuscripts involve some tacit level of bodily conduct and sensemaking.

Rowing is far more complex than typing, which may explain why relatively subtle changes in currents were rather disorienting in our case. The fact that most organizational work is more complex than rowing underscores the extent to which bringing our sense of prior situations to bear on new and evolving situations involves ongoing sensemaking. Because of the high level of bodily skill involved in responding to many novel situations, the meaning or sensibleness of ongoing activities is to be found in ongoing practical action itself, and nowhere else ‘behind’ or ‘within’ the performance of the practice. It is in this sense that we speak of a sensemaking in the flesh, in which

meaning is situated in ongoing concrete practices. Rather than treating sense as a stable mental phenomenon which can be generated in one place and applied in others without the ongoing work of further sensemaking, we see it as a feature of situated action. We are always already entangled in situations of practice that shape our responses to the present situation, yet sensemaking remains an ongoing accomplishment whenever we face substantive novelties. This orientation to practice has several implications for the sensemaking literature, which we will discuss further in the following section.

4.5.2 Implications for future studies of sensemaking

Our orientation to practices is a notable departure from the recent literature, but this is not to say that sensemaking scholarship has always neglected practice. Seminal studies in sensemaking by Weick (1995) and Schön (1983) clearly bear the influence of a range of pragmatists and phenomenologists. Addressing why the influence of these practice perspectives has waned in recent years is beyond the scope of this paper. Our more modest aim in the following paragraphs is to highlight a few contrasts and suggest ways forward for a turn, or perhaps a re-turn to practice in sensemaking research.

4.5.2.1 Sense is Provisional, Sensemaking is an Ongoing Accomplishment

By focusing on the ongoing activity that is inherent in ordinary sensemaking practices, our work departs from most contemporary studies of sensemaking. Recent studies not only depict sensemaking as occurring in discrete episodes but also tend to portray sensemaking as a process that may be ‘finished,’ resulting in relatively stable conclusions, updated cognitive schemata or shared interpretations. This is the point we are making when we say that Anton’s making sense of how to ‘chase the edge’ of the current does not necessarily involve making stable cognitive sense of a current which is not stable itself, or when we argued that seeing piracy as kind of like shortcuts made enough provisional sense to afford progress, without yielding shared conclusions regarding the actual threat of piracy.

In a recent review, Sandberg and Tsoukas (2015) critique the sensemaking literature’s “exclusive focus on disruptive episodes at the expense of more mundane forms of sensemaking implicated in routine activities.” This focus on discrete episodes is somewhat ironic, given that ‘sensemaking is ongoing’ was one of Weick’s seven properties of sensemaking (1995), and that the sensemaking perspective has been a

driving force in process organization studies. This tendency is likely due in part to methodological challenges in studying practices as they unfold; we will discuss potential ways of addressing these challenges below. First, however, it is important to acknowledge Sandberg and Tsoukas' claim that recent studies have not focused narrowly on discrete, disruptive episodes by mere coincidence. Rather, they argue convincingly that this tendency in framing empirical research reflects prevailing theoretical and ontological perspectives. Revisiting the treatment of process and temporality in our ontological perspectives is important if we are to recover and further develop Weick's treatment of the ongoing character of sensemaking.

A central theme for theories of practice is the view that "social life is an ongoing production and thus emerges through people's recurrent actions" (Feldman & Orlikowski, 2011). Such a view of social life and organization as ongoing productions is clear in Weick's discussion of retrospect. When he poses the now well-known question, "how can I know what I think until I see what I say?" he is clearly suggesting that people only make sense of what they are doing by working it out in practice. He even remarks at one point that, "investigators and practitioners alike would die for pockets of stimulus constancy in the flow of organizational life, but they seldom find them" (1995, p. 59). To develop this perspective, Weick has drawn on pragmatists such as James, Mead and Follett, as well as phenomenologists such as Schutz.

Weick's incorporation of these practice perspectives into the sensemaking literature contrasts with his earlier, more cognitivist writing. For example, in *The Social Psychology of Organizing*, Weick and Bougon (1986, p. 102-103) argued that, "organizations exist largely in the mind, and their existence takes the form of cognitive maps. Thus, what ties an organization together is what ties thoughts together." Insofar as sensemaking research emphasizes shared cognitive maps or schemas, it is likely to neglect materiality and retain the view that these maps are relatively stable even as material circumstances change. The implication of relative stability is that cognitive maps may be applied to a wide range of situations, and that they are only updated during relatively discrete episodes of acute disorientation and subsequent sensemaking activity. In contrast, practice perspectives embrace the idea that organizations are always changing, materially engaged and inevitably involved in processes of continual becoming (Tsoukas & Chia, 2002). While we admire Weick's distinctive brand of

pluralism, we agree with Sandberg and Tsoukas (2015) that practice perspectives have been neglected and merit further attention.

If we are to take ordinary ongoing sensemaking practices seriously, one of Schön's (1983, p. 104) observations bears mentioning: "this underlying process might emerge with greater clarity if Quist's [the senior architect's] demonstration were not so masterful." In a similar vein, Weick (1995, p. 49) observed that:

It seems like people can make sense of anything. This makes life easy for people who study sensemaking in the sense that their phenomenon is everywhere. But effortless sensemaking is also a curse for investigators because it means that they are more likely to see sense that has already been made than to see the actual making of it. Sensemaking tends to be swift, which means we are more likely to see products than process.

How might practice theorists approach the study of sensemaking differently? Studies that rely solely on post-hoc interviews and discursive or textual traces of sensemaking will likely continue to imply that sensemaking occurs in discrete episodes, if only because they are selecting on the dependent variable. As discussed in the methods section of this paper, videos offer distinctive means of analysing ordinary practice as it happens. Videos are still limited in some respects, however, and Nicolini's (2012, p. 213-241) outline of a theory-method bundle for studying work practices may help to explain why. He observes that practice-based research is very often performative: "as indicated by pragmatist authors, learning requires engaging with the world, embarking on an inquiry which entails intervening in the world and giving it a chance of biting back at us, our presuppositions, and our inquiry tools" (2012, p. 216). To put this in other terms, most practice theorists value some form of participation in the practices they observe. Wacquant (2011; 2015) takes a strong view of the importance of participation, arguing forcefully that complex bodily skills are difficult to understand or describe without actually acquiring them through repetitive practice. The suggestion that sensemaking might fruitfully be studied through presence and tactile experience, rather than remotely and retrospectively, highlights an important methodological dimension to our notion of sensemaking in the flesh.

4.5.2.2 Enacting a Sensible Environment

Weick's (1995) seminal book *Sensemaking in Organizations* outlines seven properties of sensemaking, the third of which is enactive of a sensible environment. His

discussion of enactment ranges widely and as a result, it is easy to selectively quote particular passages in support of rather divergent points of view. For example, at one point Weick (1995, p. 35-36) advocates a social constructionist perspective, drawing on work from Czarniawska-Joerges (1992):

A stone exists independently of our cognition; but we enact it by a cognitive bracketing, by concentrating our attention on it. Thus 'called to life,' or to attention, the stone must be socially constructed with the help of the concept of stone, its properties, and uses... every building is socially constructed. It consists of bricks, mortar, human labor, building regulations, architectural design, aesthetic expression, and so on; each of them, in turn, socially constructed and put together by a socially constructed concept of a building.

In other parts of the same chapter, however, Weick (p. 36) is clear that “enactment is first and foremost about action in the world, and not about conceptual pictures of that world (enthinkment, as Lou Pondy called it).” His extended discussion of the pragmatist Mary Parker Follett (1924) merits attention:

The centerpiece of Follett's thinking is the idea that people receive stimuli as a result of their own activity, which is suggested by the word enactment. With respect to the environment, she notes that “we are neither the master nor the slave of our environment. We cannot command and the environment obey, but also we cannot, if we would speak with the greatest accuracy, say that the organism adjusts itself to the environment, because it is only part of a larger truth. My farmer neighbors know this: we prune and graft and fertilize certain trees, and as our behavior becomes increasingly that of behavior towards apple-bearing trees, these become increasingly apple-bearing trees. The tree releases energy in me and I in it; it makes me think and plan and work, and I make it bear edible fruit. It is a process of freeing on both sides. And this is a creating process.”

In a similar discussion nearly sixty years later, Schön's pragmatist inspired account of reflective practice introduced the now widely cited notion of “design as a conversation with the materials of the situation” (1983, p. 76). Describing work in an architecture studio, he observes:

Typically, his making is complex. There are more variables—kinds of possible moves, norms, and interrelationships of these—than can be represented in a finite model. Because of this complexity, the designer's moves tend, happily or unhappily, to produce consequences other than those he intended. When this happens, the designer may take account of the unintended changes he has made in the situation by forming new appreciations and understandings and by making new moves. He shapes the situation, in accordance with his initial appreciate of it, the situation “talks back,” and he responds to the situation's back talk (Schön, 1983, p. 79).

Such ‘conversations with materials’ are not the work only of individual practitioners; they can be central to social processes of sensemaking as well: “as the musicians feel the direction of the music that is developing out of their interwoven contributions, they make new sense of it and adjust their performance to the new sense they have made” (Schön, 1983, p. 55). Schön’s discussion of how practitioners make sense of situations of complexity, ambiguity, instability, uniqueness and conflicting values has since been widely cited in a number of literatures, including recent accounts of materiality in sensemaking (Whiteman & Cooper, 2011).

While much of the recent sensemaking literature has tended towards the social constructionist perspective, our case and analysis resonate more with the treatment of materiality in Follett’s and Schön’s work. In reframing ‘enacting a sensible environment’ as a sociomaterial enactment, we aim to revive their work and re-read it in light of more recent work on materiality in organization studies. The potential tension in this diversity of perspectives was not lost on Weick. In fact, he argued that “people who study sensemaking oscillate ontologically because that is what helps them understand the actions of people in everyday life who could care less about ontology” (Weick, 1995, p. 35). We embrace Weick’s ontological pluralism, so our call for renewed attention to materiality in sensemaking practices need not be taken as an effort to discredit the cognitivist and social constructionist body of sensemaking research. We would, however, suggest that a conceptual reversal is in order for studies that would address the scant empirical attention to materiality and bodily skill in sensemaking research.

As our literature review highlighted, much recent sensemaking research has foregrounded sense, and then figured sensemaking as the activities involved in constructing said sense. In this view sense, often conceived as a matter of cognitive schemata or a relatively stable body of shared meanings, merits investigation in its own right. Insofar as such approaches subsume action under the study of how stable meanings are constructed, they may have a blind spot with respect to the skilful, tacit way that people also make provisional sense of situation particulars. Our approach has been to study sense in relation to how it matters in the more general task of situated action. This conceptual reversal supports distinctive empirical sensitivities, in our case foregrounding the skilled and sensate body in contact with the material world. Our up close and tactile notion of sensemaking in the flesh is a substantive contribution in its

own right to our understanding of sensemaking in organizations. More broadly, this conceptual reversal stands as both a challenge and an invitation to researchers whose work might ground the emergence of meaning, intelligibility or sense in the practical project of affording provisional progress in complex situations.

4.6 Conclusion

Process is fundamental: The river is not an object but an ever-changing flow; the sun is not a thing, but a flaming fire. Everything in nature is a matter of process, of activity, of change. —Rescher (1996, p. 10)

This paper presents an insider-outsider account of an extreme case: a record-setting voyage of the Amazon River. Through thick description of chasing currents and navigating the complexity of a flowing stream, we illustrate how people acquire the power to respond to perpetual change and ambiguity. Rivers have long been used as a metaphor for seeing things as processes of unrelenting change. Yet our empirical study of actual river work revealed a number of striking findings that suggest new directions for research on how people make sense of complex situations, working through challenges that feel ordinary as well as those that feel extraordinarily disruptive. Our orientation to practice is not entirely new to the sensemaking literature, indeed to some degree we are advocating for a return to the pragmatist and phenomenological insights that have long influenced the sensemaking perspective. Nonetheless, our study suggests several novel directions for sensemaking research that takes bodily sense perceptions and skills seriously, that attends to the concreteness of practices and that embraces methodological tools such as video data and participant-observation that hold potential to document sensemaking in the flesh.

4.7 References

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4.8 Chapter 4 Appendix

While lengthy, this transcript persuasively illustrates the doubt, interspersion of action and perception and general muddledness of their making sense of a potential shortcut. To view this video and several others, see: www.isaacholeman.org/dissertation.

(11:40 into video) A: Is that boat going out into it?

M: He might be drifting too.

A: He's cutting in.

M: Is it a massive cut off?

A: Ahhh, Not really. Well it depends. Not if we get stuck in water. [Standing now to peer over the water] I think that one might be sandy [i.e. too shallow]. I think we've

gotta take that little left and then around to the right. You wanna give another row for a little bit?

M: Get a little closer I think that's the best.

A: Yeah. He's [a boat in the distance] definitely going into it though.

M: If he's getting into here, right [Mark now referring to GPS, trying to align it with the actual channel they are discussing], that's just where he might be getting into to fish, so we don't want to go down that way.

A: [Bends over to look closer and indicate points on the GPS map that Mark is holding] No, we're not that far here, we're only here. So he's going in there at the moment. (12:37 into video).

They now begin rowing, perhaps turning the boat on a new course towards this channel, though the bank is so distant that it is impossible to tell in the video. Almost three minutes later Mark looks over his shoulder at the bank again and interjects:

M: You're sure that it's not a tiny little river going up, right?

A: Yeah. Now rowing until 17:51, then Anton looks over his shoulder again and says, Yeah, look. He's [a distant boat, not visible in the video] just come out of there. Then they row silently again until 21:27, then: There's something coming out of there, isn't? Is that... that a boat?

M: Yeah. That will cruise if we go straight. The same waterway.

A: Oh, hang on... I mean, that's a shorter route... that's mostly green on the map [what does this mean?]. Anton now stands again, faces the far bank and begins pointing, inaudible comments.

M: The only boat I've seen coming out of there [points] was a speed boat, and the speedboats come straight, come that direction.

A: Was it? [tone sounds mildly incredulous].

M: So there's two boats there, one there [points], a black one and a white one. They're both presumably [Anton interrupts]

A: Now there's a speedboat surely?

M: It's not the same speedboat I don't think, unless it changed around. It could have done... Oh there's another one, there's three. Is that a boat? No, probably not. That looks stationary.

A: There's stuff coming out of there, isn't there. [Sighs]. Ah, you know what, I think we should give it a run.

M: Is that a shortcut?

A: Now, yeah. Gazing silently for 8 seconds.

M: That's not this one is it [Mark refers to GPS map and Anton bends over to look more closely].

A: No it's not. That's gotta be past that one. See, look at it that way, yeah? [Anton takes the GPS, aligns it with the landscape to orient in a particular way]. Look there.

M: Yeah. That's the right direction, right? If it's the bigger water way, there's no way [Anton interrupts].

A: And there's a lot of dead wood and sand here, isn't there.

M: Oh yeah, let's go that way [they have just taken the accumulation of dead wood and sand as an indicator of current, an indicator that a substantial amount of water must be flowing into this channel to pile up such debris, and thus that it's a shortcut downstream rather than a tributary]. (video now at 23:43).

A: They begin rowing again and Anton repeats: "There's definitely boats coming out of it, so it's..." A motor becomes audible in the background.

M: I wonder where this boat is going... All three of them I think are heading the same way.

A: There's nothing up there is there, if a town was... [doesn't finish, I think he's implying that the boats could be heading to a town up a tributary but must decide that he doesn't think that's the case, the boats must be going downstream through this channel]. Now more confidently: Follow them boats Mark. Wherever they go, we go there. (it's now 24:20 and they keep rowing).

Mark now watching the two speedboats in the distance: We don't want to go that way.

A: They've come through which way? See that?

M: If they both tuck in here (Mark points, it seems slightly more upstream than the section of bank where they have been looking), that's not the one.

A: No. Unless they turn. Well, yeah, this is the one we wanted, but follow this map over [difficult to hear exactly what he says but he makes a clear gesture with his right hands, arcing more downriver than where the boats appear to be going]. They've come from that way, haven't they. This guy [referring to a third boat] however, has come from where we've come from... we need to make our run (25:14) [meaning that they're closer to the bank now and need to decide whether or not to take the channel I think?]. Rowing for another 30 seconds and then Anton stands up again to face the bank. Then bends over GPS. Inaudible comments, stands up straight again and repeats the curving gesture with his left arm, as if to indicate that they will navigate around a sandbank and into the channel downstream.

M: But, will it take us the way we want to go?

A: It's like we've come to a T-junction...

M: Where does the other route go?

A: That goes, that goes to where we want to go as well... Look how short it is [gesturing back at GPS again, presumably to the channel they think they are about to take]... another 10 second pause.

M: That's all great but if we make a mistake [Anton interrupts, pointing at the bank slightly upriver].

A: Look how much further they're going, and two of them have come from that way [pointing downstream by the channel now], so let's go that way [with tone of confidence].

M: If they've come from that way, they may be heading the opposite direction from us. They could be using it as a shortcut as well.

A: Yeah. Yeah.

M: Alright. So, we'll take the safe option.

A: Yeah. They definitely came out of that.

M: Except for the little wooden one.

A: Yeah, well, the last one came from where we came from. [They've taken their seats and are rowing again from 27:04].

M: But I don't think we've passed them [inaudible comment... They're now turning the boat on a more downstream course].

A: There's no current here anyway. So there's nothing getting pushed into there is it? I think maybe that's it.

M: We know for sure that that is a good route. It may not be the fastest but it's a good route (27:30 and they're still rowing).

A: (28:50) Great current here [affirming their change of course, perhaps. They then row silently until turning off the camera at 29:30].

5 HUMAN-CENTRED DESIGN FOR GLOBAL HEALTH EQUITY

Isaac Holeman and Dianna Kane³⁶

In this essay we argue that human-centred design is a replicable approach to innovation that puts people at the centre of activity, prioritizing their needs, desires and behaviours in the design of complex systems. As digital technologies play a growing role in health care, human-centred design is gaining traction among global health practitioners and funders. This is not to say that human-centred design is a recent development, however. It is better understood as an umbrella term with a long and

³⁶ This paper stems from our ongoing work building capacity among Medic Mobile's staff of 60+ designers, engineers and implementers, most of whom live and work locally in Kenya and Nepal. IH wrote most of the first draft in early 2016; both authors iteratively refined it. We would like to thank colleagues at the University of Cambridge, University of Edinburgh and Medic Mobile for influencing many ideas in this paper. Josh Nesbit, Jacqueline Edwards and the whole design team at Medic Mobile, participants in the Echoing Green fellowship's design community of practice, Victor Roy (University of Cambridge), Caryl Feldacker (University of Washington) and Brian Derenzi (University of Cape Town) provided insightful feedback on earlier drafts. Finally, we are deeply indebted and grateful to the many community health workers and partners with whom we have explored a more human-centred approach to global health.

complex history. Amid recent concern that human-centred design is becoming a global health and development buzzword, it is timely to reconsider what human-centred design entails and how it differs from related practices such as design thinking.

Our paper clarifies this conceptual terrain by first exploring the relevance of a conventional design thinking approach to global health practitioners. We offer insights about design thinking in formative research and discuss how iterative methods reframe the relationship between design and implementation. We then explain how human-centred design can build on and go beyond this tradition. While there is no definitive agreement about what the ‘human’ part of the term means, it often implies stakeholder participation, orienting to human skills and attention to values, human dignity or humanitarian concerns. In this view human-centred design is not a method for building technologies or for solving purely technical problems so much as it is a way of making sense of the complex challenge of health systems strengthening in a digital age.

5.1 Introduction

In 2011 the World Health Organization proclaimed that mobile technologies have the “potential to transform the face of health service delivery across the globe” (Kay & Santos, 2011, p. 1). More than 96% of the world’s population now lives within reach of a mobile phone signal (Sanou, 2015) and studies have demonstrated that this infrastructure can be used to measurably improve health outcomes (Lester et al., 2010) and to strengthen the health workforce (Zurovac et al., 2011). Labrique et al. (2013) make a compelling case for viewing mobile and web technologies as health systems strengthening tools, enabling new ways of coordinating, decentralizing and expanding the reach of care delivery.

Nonetheless, numerous researchers have registered concern with the poor scalability, reproducibility or “pilotitis” of digital health efforts in lower-income settings (Suchman, 2014; Tomlinson, Rotheram-Borus, Swartz & Tsai, 2013; Waugaman, 2013). Too many mHealth projects falter due to simplistic assumptions about end user preferences and activities, or because large-scale implementations are far more complex than small trials. Digital technologies evolve even as they are implemented, as does the process by which they are delivered. This is not only because technologies advance rapidly, but also because stakeholders often reasonably demand changes in order to

integrate multiple programs or to accommodate local infrastructure and health worker routines. Such complexity and rapid change often plays out amid the conflicting priorities of myriad decision-makers, resulting in the sort of messy challenges that design theorists call wicked problems (Buchanan, 1992). As a result it is often impractical or even amateurish to replicate evidence-based technological interventions in an inflexible “cookie-cutter” manner, let alone to trust that outcomes will be similar to those observed in small trials. These difficulties are not unique to technology innovation; many implementers are deeply aware of such challenges because they surface often in efforts to provide care in hard-to-reach communities.

In 2008 our organization established a novel intervention for coordinating community health workers using timely personalized text messages (Mahmud, Rodriguez & Nesbit, 2010; Holeman, Evans, Kane, Grant, Pagliari & Weller, 2014). Despite initial successes in small pilots, our efforts to scale-up the intervention in partnership with a wider array of health system stakeholders were beset by numerous implementation difficulties, many of which forced us to redesign the intervention. Reflecting on these wicked problems led us to cultivate a more formal and rigorous design process, and by 2010 human-centred design had become central to our approach to innovation and achieving universal coverage for mHealth interventions.

For the first few years human-centred design was a largely unfamiliar term in the global health community; justifying resources and dedicating ample time for it was usually difficult. However, the rise of digital technologies in care delivery and growing attention to implementation challenges have generated growing attentiveness to what constitutes rigorous design practice. Since 2012 dozens of authoritative global health institutions including USAID, The Gates Foundation and several United Nations agencies have elevated the conversation about human-centred design by endorsing nine principles for digital development (Waugaman, 2016). How-to guides on human-centred design for global health and social innovation have proliferated (Kimbell, 2014),³⁷ as

³⁷ For regularly updated, practitioner-friendly resources see <http://designkit.org>. For a global health and development focused set of resources sponsored by the US Agency for International Development, see <http://www.engagehcd.com>.

have news articles and white papers documenting the design experiences of healthcare organizations (Artefact Group, 2014; USAID, 2016; Veterans Affairs, 2014). We see this as a valuable development, yet there is concern in some circles that human-centred design has become a global health and development buzzword (Cheney, 2016; Guardian, 2016; Lee, 2015a; Lee, 2015b). Popular guides and case studies typically cite few if any resources for further reading in the rigorous academic literature on design (see Text Box 1). Many now use the term without reflecting critically on its implications for widely accepted models of medical evidence and practice.

Text Box 5.1: Locating the Academic Design Literature

In recent years the popular literature on design thinking and human-centred design has sparked growing interest in fields that had little prior engagement with this tradition of design research and practice, including public health and medicine, management and public policy. Books such as *Change by Design* (Brown, 2009) and *The Design of Business* (Martin, 2009) and articles such as *Design Thinking for Social Innovation* (Brown & Wyatt, 2010) have communicated design issues to a wider public, though it is generally understood among design researchers that such popular writing should not be mistaken for the rigorous primary literature (Bannon & Ehn, 2012; Bjögvinnsson, Ehn & Hillgren, 2012; Kimbell, 2011; Tonkinwise, 2016). Design literature is difficult map, however, because it is spread across several disciplines. Much of it documents the design of particular artefacts, while some concerns the nature of designing more generally. Many associate the classic view of designing as a complex human activity with seminal works by for example Schön (1983), Rittel (1973), Cross (2001), Krippendorff (1989) and Nelson and Stolterman (2003). This literature is well represented in journals such as *Design Issues*, *Design Studies* and the MIT Press series of books on design theory/design thinking.

In the last two decades the terms human-centred design, human-centred computing and human-centred systems have come to denote a distinct area of inquiry, particularly among engineering researchers (Bannon, 2011; Kling & Starr, 1998). Academic engineering conferences such as *Computer-Human Interaction* and *Computer Supported Cooperative Work* are not exclusively focused on designing, but they are important venues for such research. The psychological experiments that inform user-centred design and the related idea of user-friendliness (Norman, 2013) and the more recent but growing body of work on value-sensitive design (Friedman, 1996) are well represented in these venues. Design research including the participatory design and sociotechnical systems design traditions has been published at these engineering conferences, in information systems journals (Porra & Hirschheim, 2007; Sein, Henfridsson, Purao, Rossi & Lindgren, 2011) and at dedicated outlets such as the bi-annual *Participatory Design* conference and the journal *CoDesign*. Of particular relevance for global health practitioners is the emerging field of *Information and Communication Technology for Development* (ICT4D). According to relevant literature reviews (Dell & Kumar, 2016; Ho, Smyth, Kam & Dearden, 2009) this work is well represented in journals such as *Information Technology for Development*, publications from the academic conferences *ICTD* and *DEV*, and the more mainstream engineering conferences mentioned above.

In medicine and public health it is commonplace to ignore this broader design literature, most of which is not indexed in PubMed, or to primarily reference popular design books and toolkits in lieu of academic design research (e.g. Eckman, Gorski & Mehta, 2016; Gilliam, Martins, Bartlett, Mistretta & Holl, 2014; Gupta, Patel, Murty, Panicker & Chen, 2015; Fotso & Fogarty, 2015; Matheson, Pacione, Schultz & Klügl, 2015). However, references to such work are found more often in specialist journals such as the *Journal of Medical Internet Research* and *Journal of the Medical Informatics Association*. Systematically reviewing this vast and heterogeneous literature would do little to address the practical interest that many global health practitioners now express in human-centred design. Instead, we embrace a broadly multidisciplinary and pragmatic view of human-centred design, drawing selectively on publications from across these literatures.

To address this concern, this article reviews key concepts in design research and introduces widely-cited and influential academic resources for further reading. Based on our experiences practicing human-centred design across more than seventy mHealth initiatives in more than twenty countries, we focus on concerns that medical practitioners and advocates of health equity often raise when they first begin working with designers. In particular, we examine what human-centred design entails and how it differs from design thinking, a related term that is often used interchangeably. While design thinking departs from the status quo in medicine and public health in several substantive ways, it does not necessarily imply stakeholder participation, orienting to human skills or attention to human values. These three priorities make human-centred design distinctive and they also make it highly relevant to global health equity. In this view human-centred design is not a method for building technologies or for solving purely technical problems so much as it is a way of making sense of the complex challenge of health systems strengthening in a digital age.

5.2 What is human-centred design?

Human-centred design is a replicable approach to innovation that puts people at the centre of activity. As an umbrella term, human-centred design speaks to practices for prioritizing people's needs, values, and ordinary activities in the conception, development and implementation of complex systems. According to the International Standards Organization (ISO, 2010), human-centred design is a complex practice characterized by six principles:

- 1) the design is based upon an explicit understanding of users, tasks and environments;
- 2) users are involved throughout design and development;
- 3) the design is driven and refined by user-centred evaluation;
- 4) the process is iterative;
- 5) the design addresses the whole user experience, including the context in which the user finds his/herself;
- 6) the design team includes multidisciplinary skills and perspectives.

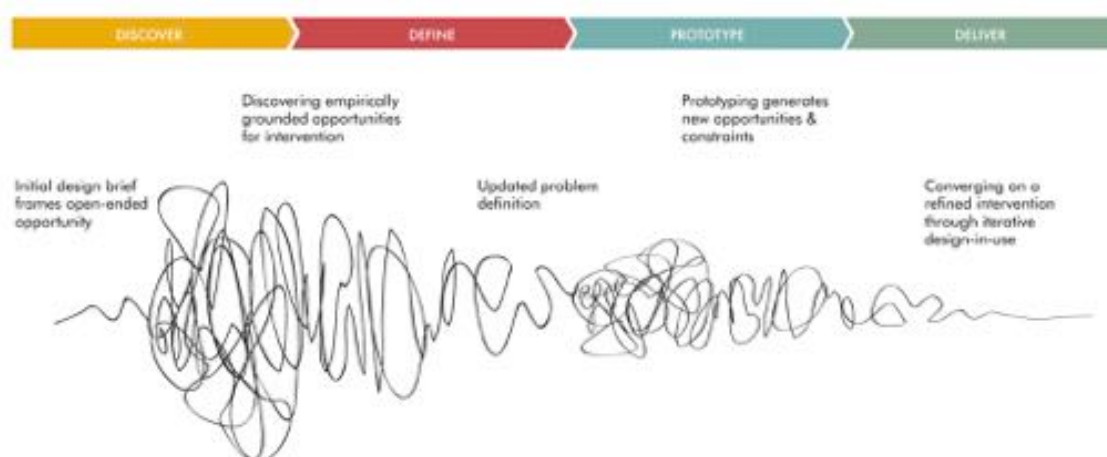
While the ISO's technical definition is a helpful starting point, it has long been argued that there is no universally-agreed view of human-centred design (Kling & Starr, 1998). Bannon (2011) emphasizes that human-centred design research and practice

continue to evolve thanks to influences from engineering and human-computer interaction, information systems research, the more craft-oriented design professions, participatory design and the social sciences. Efforts to apply human-centred design to projects of social innovation (Brown & Wyatt, 2010), international development (Brand & Schwittay, 2006; Oosterlaken, 2009) and global health (Holeman et al., 2014; Holeman, Cookson & Pagliari, 2016) continue to push this interdisciplinary practice in new directions. To clarify this conceptual terrain, we will first discuss a conventional design thinking methodology and how it differs from the status quo in public health and medicine (see Text Box 5.2). Later in the article, we will show that the term ‘human-centred’ was intended to build on and go beyond design thinking by raising several human concerns that are highly relevant to global health equity.

5.3 What is Design Thinking?

Proponents of designing thinking hold that the way designers think and work is of value to organizations pursuing innovation and to societies looking for creative approaches to solving intractable social problems (Kimbell, 2011). Figure 5.1 is a visual map of a conventional design thinking process. The squiggly line represents the iterative activities through which designers explore open-ended questions such as “how might we increase access to health information for Kenyans living on less than \$10 per day?” or “how can we improve quality of life for young mothers in India?”

Figure 5.1: Visual map of a conventional design thinking process



The front end of this process is often described as “fuzzy” because initially there is high ambiguity about what form the intervention may take (Sanders & Stappers, 2008).

Defining end user personas and clarifying their priorities and constraints enables the design team to converge on a way forward. Prototyping actual systems (whether technologies or services) generates additional insights and course-corrections. The final delivery phase is not after the design process, but rather, a chance to continue iterating. Text Box 5.2 outlines two important respects in which this process differs from discovery and innovation frameworks that are more common in medicine and public health.

Text Box 5.2: Design and the status quo in global public health and medicine		
The design practices discussed here differ from the status quo for research-based interventions in medicine and public health. At the risk of oversimplifying, the following table highlights several tendencies that may merit further reflection.		
	Medicine & Public Health	Design
Formative research	Experts review literature, apply existing evidence and behavior change theory. Stakeholders may be consulted in interviews or focus groups (Whittaker et al., 2012).	Fieldwork with stakeholders, eliciting input with prototypes. Intervention ‘users’ may become partners in idea-generation. Theory and evidence may be consulted.
Iteration	A linear, step-wise process in which pilot trials are replicated in increasingly larger and more ordinary clinical settings. Clear evidence of effectiveness is the end point (Tomlinson et al., 2013).	An iterative process begins with open-ended discovery. After evidence of effectiveness is established, iteration remains central to implementation and service integration.

5.3.1 Design thinking and formative research

A rigorous design process typically begins with intense listening and participant-observation alongside local partners. Conducting fieldwork and reflecting on the perspectives, tacit situational awareness and everyday practical workarounds of a health system’s most involved participants can clarify which technologies and workflows are likely to work in a particular setting. Often discussed in terms of cultivating empathy, ethnographic methods in design research can make work visible (Suchman, 1995) so that technical possibilities can be re-crafted to integrate more intuitively into existing patterns of technology use and care work. Such insights are vital for international teams hoping to support local maintenance, repurposing and ownership of open-source tools, longstanding aims in technology for development circles (Schumacher, 2011). In this vein, we might attend to widely available basic phones, ordinary rather than ideal

infrastructure, and the working knowledge and emotional responses of local partners with the summary phrase make it familiar.

Grounding technology design in concrete observations of people's everyday experiences means that the process is more tailored to the details of particular local situations than is the case in efforts to design interventions based on behaviour change theories (Michie, Stralen & West, 2011) or literature reviews of evidence from randomized trials in other settings. As one scientific working group put it, “one size fits all” seems distinctively non human centered” (Kling & Starr, 1998). When human-centred designers work in circumstances that they consider to be unique, they typically take best practices from evaluated interventions as guideposts rather than as rules, proactively adapting to local challenges even where those challenges were not documented elsewhere or anticipated in project specifications. This initially surprises some medical practitioners, however, the complexity of design work makes such an approach necessary. Our open-source web application has gone through more than 6,800 documented iterations³⁸ in addition to innumerable paper prototypes, workflow changes and configuration for specific projects that did not result in changes to the software codebase. This complexity means that there are far more variables to consider in any single project than there are relevant trials on which to base design decisions.

Designing in this sense is a disciplined and reflective practice (Schön, 1983); it is complementary to and should not be conflated with the expert knowledge of objective science (Cross, 2001). As discussed in the ISO standard on human-centred design (2010), the Principles for Digital Development and elsewhere (Pagliari, 2007) assembling multidisciplinary teams is a valuable opportunity to make such differences generative. Diverse teams that grasp the relevant evidence and design thinking may be more open to eliciting subtle cues and opportunities to address local complexities before proceeding to wider implementation or evaluation. In contrast, taking project scope and problem definition for granted, rather than iterating on them in light of the sometimes

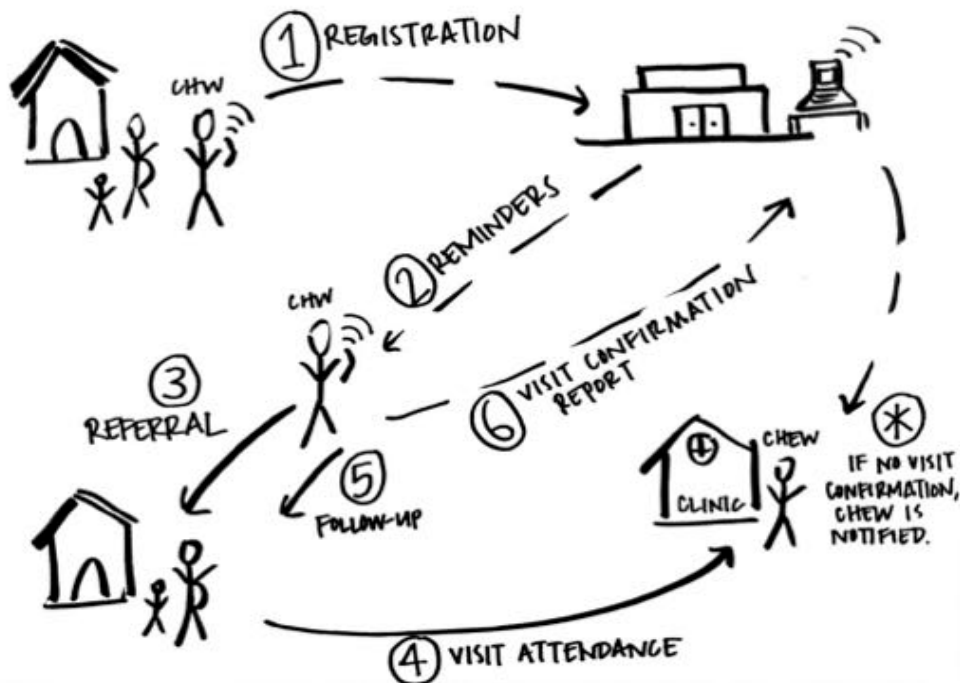
³⁸ As with most open-source applications this iteration count is publicly viewable, see <http://github.com/medic>.

ambiguous process of design discovery, can result in decisions that are biased by the implementers' implicit assumptions or personal experience.

5.3.2 Design thinking and iterative prototyping

While qualitative interviews, focus groups and even participant-observation are well established in designing digital health interventions (e.g. Whittaker, 2012), design thinking contributes a few additional methods to the practitioner's toolkit. Qualitative research methods differ from designerly inquiry in several ways, all of which have to do with the relationship between understanding situations and changing them. In design-oriented inquiry, understanding is always in the service of imagining a preferable future. To help people imagine alternative futures, designers often elicit people's views with sketches, photographs, interactive role-plays, mockups and prototypes (see Figure 2). Watching people work with prototypes can help designers to gauge participant response bias, the well-documented problem of informants telling designers what they think the designer wants to hear (Dell, Vaidyanathan, Medhi, Cutrell & Thies, 2012). However, the professional designer is not exclusively or even primarily a decision-maker in this role, but a facilitator and champion of stakeholder priorities. The aim is to make the design process transparent and generative, exploring many variations of multiple contrasting possibilities before ultimately converging on an opportunity for intervention.

Sketching and hands-on activities that provoke open-ended feedback can yield surprising insights and uncover hidden complexities that would have been inaccessible in surveys or structured interviews. Addressing the whole stakeholder experience means that designers often evoke feedback on matters that initially seemed tangential. Common cases include revealing that an intervention for one health issue cannot proceed without changes in adjacent programs, or a practical manner in which local electricity access or the need to coordinate with other health workers can constrain technology use. Working in this way yields insights about the practicality, perceived value and potential adoption of an intervention before initiating a costly pilot study. It also avoids health worker frustration or burnout with poorly validated interventions. By reframing "human error" or "poor adoption" as opportunities to redesign digital tools and user workflows, iterative approaches relieve users of the expectation to embrace pre-determined interventions that might not have reflected local priorities.

Figure 5.2: Sketch of an SMS-enabled antenatal care intervention

In this example mockup of the workflow or mechanism of action for an antenatal care (ANC) intervention, 1) a community health worker (CHW) registers a pregnant woman via SMS; 2) software installed at a hospital automatically creates a schedule of appropriately-spaced ANC visits and sends the CHW personalized notifications before each appointment; 3) the CHW re-visits the household to refer the woman for ANC; 4) typically the pregnant woman visits clinic; 5) the CHW follows up a few days later and 6) sends an SMS to confirm that the appointment was attended. If no SMS confirmation is received, the CHW's manager (the CHEW) is automatically notified. Partners often find such workflow sketches more participatory and accessible to input (especially across language, culture and power barriers) than technical product specifications or detailed written/verbal descriptions alone. New projects involve many variations of such sketches as designs for technology and service delivery co-evolve.

Iterative prototyping typically continues through design-in-use, reconfiguring technologies in response to difficulties that only emerge through implementation and sustained use of technology. Designers cannot always predict or control such complexities but they can adapt to them when they emerge in practice. Some researchers refer to this iterative integration of proactive design and organic evolution as guided emergence (Sein et al., 2011). A consequence of taking emergence seriously is that technology design cannot be fully divorced from the redesign of work practices and the organization of health systems. The term sociotechnical systems design (Scacchi,

2004) underscores that technical systems and social systems, including organizations and models of care, are entangled in practice and should be redesigned together.

Constant iteration is not unique to human-centred design; it is similarly central for example in agile software development methods (Beck et al., 2001). Nonetheless, iteration bears special reflection in the global health community because widely accepted models of medical evidence stipulate intervention design, evidence generation and replication as separate phases (Tomlinson et al., 2013). Design thinking necessarily blurs the traditional separation of design and implementation, revisiting key design considerations at iteration meetings throughout every stage of scale up and replication. In our own work, this has underscored the value of hiring and cultivating the expertise of local designers who are more available for frequent design iterations.

5.4 The importance of being ‘human’ centred

Even a cursory inspection will reveal that there is little consensus, among practitioners or researchers, about what the ‘human’ part of human-centred design is supposed to mean. Many people discuss human-centred design, design thinking and user-centred design interchangeably.³⁹ With this casual use of these terms, people are not necessarily committed to any overarching conceptual framework and may simply invoke a range of themes and design practices that involve people and social issues. The lack of clarity can seem problematic, however, in light of recent critiques of buzzwords and empty rhetoric in design for global health and development:

Empowerment and agency and human-centricity have come to seem like euphemistic ways to get donors to feel like they are not engaging in neo-colonial practices by defining and determining the presence of healthcare for populations worlds away from their own. (Guardian, 2016).

While hollow design rhetoric has recently surfaced in a distinctive way, the problem is hardly new. Almost two decades ago, a scientific working group wrote that they “were

³⁹ For example the ISO standard on human-centred design (2010, p. 2) observes that many see user-centred design as a synonym, though the term human-centered may imply attention to a wider range of stakeholders in addition to technology users. Similarly, Brown and Wyatt (2010) discuss human-centred design and design thinking interchangeably.

especially concerned that the term ‘human-centred’ could easily become a trivialized buzzword that could casually be slapped as a label onto any computer application that seemed to help people” (Kling & Starr, 1998). In their view and in a great deal of subsequent work, the ‘human’ part of human-centred design is better understood as a paradigm shift, distinct from prior notions of user-centeredness insofar as it emphasizes a more holistic attitude toward the whole person and their activities in broader organizational and social context. For many the term human-centred goes well beyond conventional design thinking, involving specific conceptual and even ethical commitments related to stakeholder participation, orienting to people’s skills and surfacing the values at stake in design work.

5.4.1 Participatory design

Stakeholder participation is a touchstone for those who associate the term human-centred with engaging people as partners, rather than viewing designers as experts and potential users as mere informants. For many in the international development community, longstanding traditions of participatory development (Chambers, 1994; Freire, 2014; Holeman, Cookson & Pagliari, 2016) are a relevant point of reference. While some suggest that human-centred design was developed by private sector innovators (Lee, 2015a), participatory design actually emerged in the 1970s out of Scandinavia’s workplace democracy movement (Simonsen & Robertson, 2012). In partnerships among academics and labour unions, participatory design was explicitly political (the democratic view that workers should have a say) and pragmatic (people are more likely to adopt tools that reflect their priorities).

Many now use the term co-design together with participatory design (Sanders & Stappers, 2008). Some work emphasizes engaging users as partners in idea generation rather than as passive informants whose role is to provide feedback on concepts developed by expert designers (Yoo, Hultdtgren, Woelfer, Hendry & Friedman, 2013). This is not to say that human-centred design is inevitably democratic; user participation can be neglected or depoliticized in a manner that grants no real power to non-experts. For this reason, if we are to claim that a design process was human-centred because it ‘involved the user,’ it is worth documenting whether or how stakeholder participation substantively shaped the outcomes of the design process.

5.4.2 Supporting human skills

For many the term human-centred also evokes a commitment to augmenting people's skills and competencies (Bannon, 2011). This perspective is perhaps best understood in contrast to an earlier approach to workplace automation, in which technology was often used to improve productivity by making workers obsolete or by monitoring and controlling their behaviour. Since the 1940s, proponents of sociotechnical design have decried industrial technology projects that they described as increasing monotony, reducing worker autonomy and generally having “dehumanizing” effects on the workplace experience. Having documented how technology-driven efficiency can come at the expense of human dignity, such critiques emphasize the importance of “designing human systems” (Mumford, 1987) in an iterative and participatory manner.

As the reach of automation extended out from the factory and into the office, efforts to computerize were often met with a sceptical, anti-computerization sentiment. This engendered calls for “learning how to humanely integrate new computer-based technologies into routine social life” and the search for “a coherent alternative humanistic vision for appropriate computerization” (Kling & Iacono, 1988, p. 226-236). Early discussions of human-centred design pleaded that we design new information systems without repeating the dehumanizing mistakes of technology design in the industrial revolution (Cooley, 2000). Subsequent work has affirmed that these calls for a more human-centred approach to automation and computerization were an influential precursor to human-centred design as we know it today (Bannon, 2011). Thus by the time the term human-centred was gaining currency in the 1990s, researchers were already drawing on decades of studies to argue that “human-centred systems are designed to complement humans' skills... design predicated on merely replacing or automating human activity is not human centered” (Kling & Starr, 1998, p. 24).

An orientation to augmenting skills or supporting cooperative work remains highly relevant to global health, given that a recent review of digital media in public health characterized the majority of work as “just telling and selling” (Clar et al., 2014). A design challenge such as “what kinds of SMS message content are engaging enough to change poor people's health seeking behaviour?” might reflect a preconception that eventually replacing community health workers with text messages, for the sake of

efficiency or scalability, would be good. The design challenge, "how can we better support community health workers in the task of coordinating care?" reflects different preconceptions and some would say more human-centred aims. While user feedback and co-design activities are undoubtedly worthwhile, it should not be taken for granted that they will overcome powerful preconceptions about the purpose of technology and the opportunity for designers to support, or obviate, human skills and care work.

5.4.3 Human values

Another aspect of human-centred designing is articulating the human values at stake and the moral stances implicit in particular design projects. This premise is based on decades of empirical research documenting the problems and paradoxes of information systems efforts gone awry during the course of implementation in diverse social and organizational contexts (Kling & Starr, 1998). This means examining stakeholder values, designer values and potential value conflicts, in addition to the priorities (such as averting child mortality) explicitly supported by the systems being designed. For the growing literature on value-sensitive design (Friedman, 1996; Walton & DeRenzi, 2009), it may include theory and formal methods for conceptual, technical and empirical investigations at the individual, group and societal levels of analysis. An important conversation here has to do with the merit of listing and implementing universal human values (honesty, reliability, transparency etc.), or alternatively focusing on methods for reflecting the values of the people likely to be influenced by an intervention (Borning & Muller, 2012; Houston, Jackson, Rosner, Ahmed, Young & Kang, 2016). Even when human-centred designers do not embrace the formal methods or practices of value-sensitive design, we would do well to reflect on the moral stances we imply when we talk of 'human' concerns and use related words to describe our work.

For many designers, working in the fields of global health and development has meant reflecting on matters of inequality and health equity. This is not a recent development; in his 1971 classic *Design for the Real World*, Victor Papanek drew attention to "the basic survival problems of humanity today" and argued forcefully that "in a world brought nearly to its knees by abject want, a preoccupation with 'making things pretty' is a crime against humanity" (p. 327). Working in such contexts, some designers discuss human-centred perspectives alongside human rights, human dignity or

humanitarian concern (Buchanan, 2001). When designers use terms such as human-centred, humane, (de)humanizing, humanity, human dignity and human rights in this manner, they are not all working from the same definition. Their language is not united by a single overarching characteristic, and yet we can clearly recognize a cluster of overlapping meanings, with each effort recognizing people's humanity in its own way. These terms are not purely analytical; they also imply certain values or moral stances that can and often do shape the course of design work.

Such language has long been important in the global health community. As Lancet editor Richard Horton put it, “global health is an attitude. It is a way of looking at the world. It is about the universal nature of our human predicament. It is a statement about our commitment to health as a fundamental quality of liberty and equity” (Farmer, Kim, Kleinman & Basilio, 2013, p. xv). Many global health practitioners recognize that the poorest people are systematically more likely to be exposed to disease and harm and less likely to access working health systems or robust technologies (Farmer, Nizeye, Stulac & Keshavjee, 2006), let alone opportunities to redesign either. Recognizing this trend, global health advocates Farmer and Gutierrez argue that we assert our humanity in the struggle for a more just and caring society, in which people can live with dignity and become the authors of their own destinies (2013, p. 57). Their call to build “a preferential option for the poor” and marginalized suggests a broader and more challenging remit for human-centeredness. In an interview with Wired magazine, Farmer was asked to address how his perspective on human-centred design might work in practice:

In Haiti I would see people sleeping outside the hospital with their donkey saddle under their neck—they'd been waiting there for days. And no one was asking them, “What are you eating while you're waiting? What is your family eating while you're gone?” We have to design a health delivery system by actually talking to people and asking, “What would make this service better for you?” (Roper, 2013).

To rephrase this challenge in more general terms, efforts to build technologies or solve technical problems can hardly claim to be human-centred if they systematically ignore human rights and humanitarian concerns in nearby aspects of the health system. Attending to such human concerns involves looking beyond the design of digital tools to reimagine services and the organization of health systems. This wider scope for design is probably inevitable if we take seriously the contrast that distinguishes human-centred

approaches from a focus on ‘the user’ in the first place—the call to reframe local matters of usability or user satisfaction in relation to the broader life contexts of health workers and patients. Some will see this as hubris, a presumption that savvy methods and attitudes will enable the designer to resolve all imaginable difficulties. But it can also be seen as a call for humility; the difference depends on how we designers locate ourselves relative to other stakeholders and take responsibility for recognizing even those complexities which we cannot yet imagine how to resolve.⁴⁰

In summary, there are at least three ways that global health practitioners might judge whether the language of human-centeredness is being used substantively. Human-centred design efforts may be characterized by:

- 1) substantive and documented participation of people who will use the tools in their routine activities;
- 2) orienting to people’s skills and supporting cooperative work, rather than automating solely for the sake of efficiency or managerial control; and
- 3) concern for the whole person and their life experiences, reframing purely technical issues in relation to people’s values and the broader human context of implementation.

While some treat human-centred design as a method for building technologies or solving narrowly technical problems (Janzer & Weinstein, 2014), these themes suggest a broader remit. A growing number of researchers imply such a broader view when they write about design as an ongoing and critical approach to making sense of complex and intractable social challenges (Dorst, 2015; Manzini & Coad, 2015; Tonkinwise, 2016). This perspective has implications for how we select where to undertake design projects, who to involve as design partners and which health issues to frame as design challenges. However, as ICT for Development researchers have observed (Anokwa et al., 2009), decisions that prioritize (or neglect) marginalized communities or diseases that disproportionately affect the poorest of the poor are often made implicitly, before any application of formal design methods. This underscores the difficulty of putting principles into practice, which some practitioner communities have already recognized (Waugaman, 2016). To be sure, there is nothing inevitably participatory or humane in

⁴⁰ A similar point is made in Suchman, L., (1995). *Speech Acts and Voices: Response to Winograd et al. Computer Supported Cooperative Work*. 3(1), 85–95.

claiming to practice human-centred design, much as there is nothing inevitably caring about the way we provide health care. An ongoing challenge for practitioners and researchers alike will be to explore and document concrete limitations, pitfalls and success stories in practicing human-centred design for global health equity.

5.5 Conclusion: Why design matters for global health equity

Human-centred design is an umbrella term with a complex history. While human-centred design only emerged as a distinct area of research and practice in the 1990s, we argued that it builds on a wider tradition of design research and practice. Applied to global health, designing involves fieldwork and is oriented to the concerns of particular local health systems, though it may take behaviour change theories or evidence from randomized trials as guide posts. And while design thinking begins with formative research, iterative cycles of implementation and redesign often continue as interventions are scaled-up into well-integrated, sustainable health systems.

The risk that human-centred design is becoming a buzzword is worth taking seriously. Our paper outlines three ways of judging the substance of rhetoric about human-centeredness in terms of the concrete aims and practices of particular design projects. Participation and partnership, support for skilled and cooperative care work, and attention to human values make human-centred design distinct from the related practice of design thinking. Moreover, these themes are of particular relevance for projects of global health equity. They merit further empirical research and discussion in the global digital health literature, considering not only successful cases but also pitfalls and limitations in real world practice.

Given the “pilotitis” and poor reproducibility of successes in digital health (Tomlinson et al., 2013; Shuchman, 2014) a growing number of authoritative global health institutions have concluded that good design should no longer be regarded as a luxury (Waugaman, 2016). This implies that pilotitis cannot be addressed through implementation alone; accounting for the broader human context of implementation will involve embracing complexity in the ongoing process of design and iterative design-in-use. Human-centred design is attuned to working through unique, uncertain and rapidly changing situations in a pragmatic and repeatable manner. In this view it is not restricted to building technologies or solving purely technical problems so much as it is

about making sense of the complex challenge of health systems strengthening in a digital age. This is not to say that the design practitioner can guarantee good outcomes; treating human-centred design as a panacea would rob it of this generative openness to complexity. Limitations notwithstanding, human-centred design has much to offer for innovation in digital health, for implementation research and for efforts to integrate fragmented delivery systems to achieve global health equity.

5.6 References

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6 CONCLUSION

6.1 Sensemaking and Human-Centred Design: A Practice Perspective

Through ethnographic cases in ICT for global health and development and an unlikely voyage of the Amazon river, this dissertation explores how sensemaking and human-centred design are relevant to a wide range of settings. By selecting cases that are relatively diverse, the portfolio also throws into sharp relief something that sensemaking and human-centred design have in common: they can serve as practical ways of organizing responses to complexity, ambiguity, uniqueness, conflicting values and rapid change. In each chapter, Schön's (1983) notion of reflective practice grounds and guides the analysis. Building on Schön's insights about designing as a conversation with the materials of the situation, and in particular the notion that material back talk plays a generative role in this process, my research enters a timely debate among organizational practice theorists concerning the notion of sociomaterial practices. The portfolio as a whole offers a creative re-reading of Schön's work that emphasizes synthesis and building on rather than rejecting prior scholarship. However, it must be acknowledged that each chapter enters the broader literature in its own way, as a standalone article and in reference to several distinct disciplinary conversations. Before I reflect on the arc of the thesis more holistically, a recapitulation of these several contributions may elucidate how the process of peer review has shaped them thus far.

6.1.1 Reflections on Peer Review and Joining Disciplinary Conversations

In the introductory chapter I observed that in many fields of study, book length monographs are no longer a common feature of the academic's tenure portfolio. In light of this trend, the portfolio format dissertation reflects 'the state of the art' in the sense that it allows a series of standalone contributions to be shaped through the creative and cooperative process of peer review, for the doctoral candidate much as for the senior researcher. I speak of my work in reference to the state of the art with some humility, because I cannot say that my experiences with the state of our discipline have been uniformly positive.

My first core chapter, a theoretical essay, makes the case for a more pluralistic approach to theorizing sociomaterial practices. Like James' (1907) framing of pragmatism, I describe *room for silence* as a new name in a novel context for some old ways of thinking. In an important sense this essay was a reflective response to my progress on the two empirical chapters. It was an attempt to offer a coherent conceptual defence of having theorized sociomaterial practices a little differently in Chapter 3 than in Chapter 4. In a more direct sense, however, it was a response to some of the patronizing and poorly informed comments I received from conference attendees and anonymous peer reviewers concerning earlier versions of Chapter 3. A common version of these comments goes along the lines of, "I don't see why you would use sociomateriality when something more familiar like [ANT/structuration/phenomenology/insert my favourite theory] would do." Such questions can be collegial and enlightening when offered in a generative tone and in the right context, but they are often thrust forth in a sore or derisive tone. When made in the context of anonymous peer review, they can come across as thinly veiled threats. For example, this comment came with the third round of major revisions for Chapter 3:

You also need to be clear on a critical realist perspective if you are to discuss design connected to sociomateriality. Paul Leonardi's work is particularly useful for you, especially his 2012 paper in Information and Organization on where he forwards CR as a basis to study sociomateriality.

I had studiously avoided citing Leonardi's work or anyone else's on the philosophical foundations of sociomateriality, not because I have any qualms whatsoever with critical realism or with Leonardi's writing; in fact I have enjoyed reading it. But Leonardi (2012)

and Mutch (2012) made the discussion of sociomaterial practices lurch in a philosophical direction. In my humble opinion, building and defending systematic philosophical systems is not what ethnographies of ICT4D initiatives are for. At the very least I lack the qualifications and the appetite for it, but I was not allowed to remain silent on the matter. This editorial comment, in the broader context of the review letter, persuaded me that Leonardi or one of his followers was among my anonymous reviewers (or anonymous co-authors as it had begun to feel), and for this reason I decided to comment favourably on critical realism in our paper. Bear in mind my position as a junior researcher with no PhD stipend remaining and no academic prospects at the time, the currency that “A list” publications hold in the academic job market and the obvious power differentials that characterize peer review. Responding boldly within this paper and this review process seemed far too risky, so I responded by writing Room for Silence. I call it room for silence rather than, say, a critique of empirical philosophy, because I have no qualms with the production of big ideas; it is their enforcement that irks me.

The framing of Chapter 3 also merits further reflection because the paper’s orientation to the imbrication literature came as a surprise, at the suggestion of our editor, with our third round of major revisions. During the first round of fieldwork and in the writing of my masters dissertation, I had drawn on Pickering’s (1995) notion that the ‘tuning’ of human and material agencies gives rise to the mangle of practice. This work comes from science and technology studies, is explicitly concerned with the ontological form of invented objects and it is one of the well cited works that Orlikowski and Scott (2008) group under the sociomaterial practice umbrella. In the first year of my PhD I discovered Schön’s (1986) work and embraced his notions of ‘conversations with materials’ and ‘material back talk’ because I saw these as resonant with Pickering’s ontological reflections while also offering a more pragmatic perspective on design issues. Until recently, every version of Chapter 3 featured Pickering and Schön prominently.

Both perspectives have much in common with the conversation about imbricating human and material agencies that we ended up joining with Chapter 3. I am convinced that there are greater differences within each of these discourses than there are between them. As I discuss in Chapter 2, it is understandable that *The Reflective Practitioner* would have diverse intellectual descendants given that the book now has well over

50,000 citations. In the discussion of imbrication: consider Ciborra's (2006) image of imbrication as unfolding imbroglio for which the image of a 'net' is too Cartesian and tidy. This is easily as close to Pickering's 'mangle' of practice or Schön's 'confusing swampy messes' as it is to Leonardi's (2011) relatively orderly image of imbrication as roof tiles in an interlocking, durable grid pattern.

That said, all three metaphors bear a certain family resemblance by which we can distinguish them from a range of other perspectives. Specifically, all three explicitly call out a role for materiality as *inevitably* integral to an unfolding generative process: a conversation with materials, a process of tuning or imbricating human and material elements. Importantly, all three notions evoke a highly processual dynamic that is amenable to foregrounding the perspective of practitioners. Pickering articulates this point artfully when he describes his work as a constructive dialog with the actor-network (1995, p. 11-15), one in which the human capacity for imagination or foresight, planning and goal directed behaviour is more noticeable. Lay practitioners may well see themselves as conversing with materials, as tuning an instrument or artefact, as interweaving human and material elements in a way that they are unlikely to see themselves as "translating actor networks." In this way the language and metaphors of these three works are not quite so post-human as some other strands of the sociomaterial practice discourse.

Secondly I would point out that explicit attention to how materiality makes a difference (that is to say, has an agential influence in directing the course of affairs) differentiates this work from a range of theories that seem open to materiality but do not require attending to it in this way. For example in Chapter 3 I write that much of the work using Winograd and Flores' (1986) language action perspective has neglected materiality, even though Winograd and Flores' original work does in fact feature a discussion of performative things. Similarly in Chapter 2 I show that many practice theorists have been writing about practice as a narrowly "social" phenomenon, even while citing Reckwitz's (2002) definition of practices, in which things and their uses are inseparable. I might add that I use Wacquant's (2004) book *Body and Soul* in Chapter 4 because it engages Bourdieusian notions of practice and habitus in a deeply visceral manner. Yet in organization studies, much of the work on habitus treats it as a narrowly social, i.e. not material, phenomenon. Literatures on bricolage, improvisation and some

perspectives on sensemaking may similarly be open to materiality but do not in any strong sense require it.

Given the similarities of conversations with materials, tuning and imbrication, the decision to feature contributions to the literature on imbrication in Chapter 3 was driven primarily by the fact that our paper was under review at an information systems journal. Pickering looms large in science and technology studies; Leonardi's work on imbrication is better known among information systems researchers. This is not all negative; building a research community involves cooperation and my co-author and I were delighted to find a concrete way of contributing to the imbrication literature. After all we never saw imbrication as a bad fit for our work, just not the fit we had initially intended.

Unfortunately Chapter 5 has fared far worse, which may be unsurprising because it is multidisciplinary and practitioner-facing to a degree that scholarly reviewers seem to find bewildering or even insolent. To date it has been rejected by six medical, global health and digital health journals. One psychologist wrote that an earlier version of the manuscript “doesn't really capture any of the truly ‘human-centred’ work in ehealth or mhealth,” without bothering to direct me to any of this so called *truly* human-centered work. An anthropologist very politely called the paper “dehumanizing” because we had reviewed abstract conceptual issues related to human-centred design without offering humanizing vignettes. The paper did not even get a revise and resubmit offer from a journal that claims to publish all research that relates to technology for health and exhibits a basic standard of rigor, regardless of novelty or apparent potential for impact. Most reviewers have pointed out either our failure to cite enough research in whatever minute sub-discipline they labour in, or that our argument is not truly novel enough to be a contribution to whatever minute sub-discipline they call home. Throughout this process it has been striking how little reviewers and editors seem to know or care what issues and topics of discussion are of timely concern in the global health practitioner and policy maker community. But what I find unconscionable from a scholarly perspective is how unhelpful these experiences of submission and rejection have been in identifying any concrete errors of fact, logic or clarity of presentation, other than our failure to ‘fit in’ with the divergent disciplinary forms that the various reviewers find familiar.

Meanwhile, we continue to get truly glowing feedback from students and friendly reviewers within the academy and beyond. A research collaborator with a global health background commented, “this was an interesting article, I think this type of article can be hard to get published but I learned a lot!” After reading the article another NIH funded researcher, influential within health policy circles in Kenya, proposed that we make human-centred design more central to our next joint research proposal. Many Medic Mobile partners and all of the students in the MSc level mHealth course I teach have read the paper and the ensuing conversations have been enlightening. Every new Medic Mobile employee reads the paper (we have hired at least twenty people since I wrote the first draft) as part of their on-boarding. One new employee reached out to schedule a Skype call after reading the paper; she explained that she had felt unsatisfied with the research orientation of her masters program in global health but had found new purpose and interest in research after reading this article. So far I have been emailed four times by people checking in to ask whether the paper has been published yet, so that they can cite it in their own articles and Masters and PhD dissertations.

The fact that the text already has a life of its own is perhaps the only reason I have the nerve to continue sending it out for review. The whole experience has made me feel as if I were on a Quixotic journey seeking any actual peers—people who care about practicing human-centred design in the field of global health—with enough academic stature to be called on by my editors. In the introductory chapter I offered a more glowing outline of this creative and cooperative process—the approved vision of peer review which I so properly was taught in Cambridge. This practical reflection on the darker side of peer review may balance that image. I still believe in scholarly cooperation through peer review, but it is far from easy, let alone delightful. Such experiences throw into sharp relief the disciplining effects of orienting to “the literature,” which is to say picking a narrow theory-governed discourse within a specific discipline, as a central point of good scholarship. In the following section, I attempt to let these fetters fall away and offer some integrated reflections on the arc of this thesis.

6.1.2 Contributions of the Thesis as a Whole

This thesis began with a period of extended personal reflection and the hope of joining with other researchers in a conversation about human-centred design for global

health equity. In my understanding, this implies a concern with strengthening health systems and broadly addressing humanitarian concerns for and with people living in poverty. As insiders know, this work is seldom smooth or pretty. Practitioners often find themselves caught in a web of challenges which forces them to deviate from well laid plans and idealistic procedures. Of course there is what Schön (1983) called a ‘high, hard ground’ of interesting technical problems which can forthrightly be solved through application of systematic, research-based theory and technique, but these problems are often of relatively smaller human consequence. This thesis is more concerned with problems of the ‘swampy lowland’ which often feel like confusing messes, incapable of straightforward technical solution. These *wicked problems* (Buchanan, 1992; Rittel & Webber, 1973) are often of great human consequence, yet they are characterized by complexity, ambiguity, conflicting priorities, rapid change and never enough time or resources.

Proponents of designing thinking hold that the way designers think and work is of value to organizations pursuing innovation and to societies looking for creative approaches to solving intractable social problems (Kimbell, 2011). I believe that design perspectives are thriving beyond the design profession, at least in part, because so many other approaches to professional practice have become increasingly technocratic, typically in the name of evidence-based medicine/policy/management/something. In the name of rigor, these formal approaches to professional work inoculate themselves against the complex sensemaking that practitioners continue to find indispensable. Yet design thinking is far from the only way of making sense of surprising complexity, ambiguity, conflicting priorities or rapid change. Sensemaking is a more general human activity, extensively documented in organizational research that I cite throughout this dissertation. Emphasizing wicked problems and their broad impact in global health and humanitarian work highlights the relevance of sensemaking, and thus clarifies the concrete role for human-centred design, in these fields of practice. To further develop this link in Chapter One, I introduce one of this dissertation’s guiding questions:

What can we learn from more general studies of sensemaking, that may help us understand the nature or relevance of a human-centred design practice that goes beyond technical fixes to generate responses to more complex human challenges?

I address this question most directly in Chapter Four. Emphasizing bodily senses and skills, this chapter sketches a tactile notion of sensemaking that I call *sensemaking in the flesh*. I use this term to suggest physical presence and to connote contact and materiality beyond human bodies—to flesh out is to add substance. In the flesh also suggests studying sense from its point of production, a perspective *from* practice rather than a spectator’s study of it. Given that recent studies of sensemaking have tended to depict the phenomenon as a cognitive process centred on interpretation, our more tactile perspective draws attention to the concrete practices through which people allow themselves to experience a barrage of cues and begin to feel that sensemaking is needed in the first place.

Applied to design practice, one implication of taking sensemaking seriously is that we will often uncover hidden complexities, encounter material back talk or evoke stakeholder feedback on matters that seem tangential to our initial sense of the design opportunity. If our design practice begins with open-ended discovery and a substantive commitment to approaching wicked problems with nuance, we will not always be able to predict what form our interventions may take. While open source software has played a recurring role in my own design practice, I have also found myself designing hardware, print materials for data analysis or training, new health services and ancillary maintenance roles and services, employee on-boarding experiences and satisfaction surveys, revenue models and strategies for scaling an open source community—the myriad features of what we might call organizational life. This is often a humbling experience; it never unfolds precisely as I initially hope. While some aspects of the Medic Mobile journey are distinctive, I would argue that broad and disorienting reflection—even soul searching—on what exactly we should be designing is far from unique. This wider scope for design practice is probably inevitable if we take seriously the contrast that distinguishes human-centered approaches from a focus on ‘the user’ in the first place—the call to reframe local matters of usability or user satisfaction in relation to the broader life experiences of concerned stakeholders. This is why the other core empirical question that I introduced in Chapter 1, while stemming from my own experiences as a practitioner, is of broad conceptual relevance to the conversation about human-centered design for global health equity:

What exactly can design work be said to produce, when we recognize that designers matter but are far from all powerful, that they build technologies but also remain deeply concerned with health systems and organizations?

I address this question directly with Chapter 3, developing the notion of *designing for the emergence of new practices*. Exploring the implementation and iterative redesign of an Internet of Things technology for immunization in rural Kenya, this chapter emphasizes the situated nature of design work. Reflecting on how a relatively discrete artefact related in practice to local infrastructure and health worker activities, this chapter highlights the generative role of material back talk in the design process. In so doing, it emphasizes that designers play a concretely limited, yet consequential role in guiding the emergence of sociomaterial practices. Drawing on the metaphor of imbrication, this chapter emphasizes that practices could not unfold as they do without the specific interlocking of human activity and materiality. This process-oriented view of giving form to sociomaterial practices is more nuanced and holistic than simply enumerating recurring elements of software, hardware, gestures, routines, strategies etc.

The notion of sociomaterial practices is admittedly complex and little known outside of a relatively focused scholarly discourse. It has made little headway for example among global health researchers, not to mention the practitioner community. For the outside observer, it could be confusing that I write about sociomaterial practices rather differently in Chapter 3 than I do in Chapter 4. If this term is to travel well, we must address questions related to the breadth, diversity and limits of the phenomena we mean to invoke when we speak of practices. As I put it in Chapter 1, the third substantive question that this thesis addresses is:

What does it mean to discuss sociomaterial practice as an umbrella term; can there be a logically coherent, conceptually sophisticated basis for pluralism within this discourse?

Such questions are better addressed through a literature review than through any single empirical contribution. For this reason Chapter 2 is structured as a review essay, including a brief empirical sketch for illustrative purposes. In this essay I explain that all theories of practice emphasize recurring activity and the concrete details of how people perform their work, with a process-oriented and relational view of social life as an ongoing production. These perspectives locate ‘the social’ not in individual choices or social norms but in concrete practices, which Reckwitz (2002) describes as “routinized

forms of bodily activities, forms of mental activities, ‘things’ and their use, a background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge” (p. 249). In ordinary use the word practice may simply refer to how people work. Practice theories generally also hold that a practice “forms so to speak a ‘block’ whose existence necessarily depends on the existence and specific interconnectedness of these elements, and which cannot be reduced to any one of these single elements” (Reckwitz, 2002, p. 250).

The essay analyses in detail the pluralism that is implicit in the notion of a ‘practice turn’ in social theory. In so doing it offers a coherent basis for extending this pluralism to the study of sociomaterial practices. This is not to say that ‘anything goes’ with the label sociomaterial. Rather, it is to reject hard and fast rules, lists of required conceptual elements or magisterial command of philosophical debates as the exclusive standards for whether an empirical contribution to learning may pass through the rigors of peer review. Holding that meaningful uses of the term sociomaterial practice should bear a clear *family resemblance* is a more artful and more pluralistic standard. Broad qualities of the sociomaterial practice family resemblance include challenging the common separation of people’s working from concrete materials, a scepticism of tech-deterministic and tech-utopian perspectives, and a similar scepticism of immaterial ‘social’ or cultural explanations, which all too often seem almost to celebrate naïve inattention to real technical concerns.

In contrast with the general trend in the IS discipline, I have additionally argued that sociomaterial suggests openness to a broad range of materials rather than associating materiality narrowly with the object de jure (be it software, hardware, buildings, the human body, vaccines, infectious diseases etc.) of one’s home discipline. This broader view of materiality is quite apparent in the influences from science and technology studies that Orlikowski (2007) cites in her seminal work on sociomaterial practices. In my personal view, the pressure to focus more narrowly has to do with the disciplining effects of peer review. Some of us want to focus narrowly; almost all of us do so when editors and anonymous co-authors tell us that we must, to fit with their journal.

Whether or not a broader view of materiality gains favour as a central feature of the sociomaterial practice discourse, the notion of family resemblance implies that these features may manifest in very different ways from case to case, and that those most

familiar with the family may reasonably recognize a resemblance even when some features are missing. For example, I find Leonardi's conflation of "materiality" with "those properties of the artifact that do not change from one moment to the next or across differences in location" (2012, p. 7) tediously narrow, but far be it from me to say that his contributions are not *properly* under the sociomaterial practice umbrella.

Some studies of sociomaterial practices will undoubtedly continue to advocate for philosophical theories of all objects, both because study authors have an appetite for it and because reviewers may force their hands. I develop the notion of *room for silence* to express my enthusiasm for such work, while simultaneously insisting that we not require philosophical debate. My argument is rooted in a venerable tradition of pragmatic and ethnomethodological thought, and it is particularly important for studies that emphasize empirical insights concerning matters of great human concern. With this point in mind, let us now turn to some practical implications of the thesis as a whole.

To embrace what I call *designing for the emergence of sociomaterial practices* implies holistic perspective on what designers produce, these integrated bundles of human activity and software, hardware, etc. As an expression of humility, it involves drawing a contrast with the view that any solitary human can design practices all on her own. In truth, designers grapple with a range of emergent complexities that often evade their foresight in requirements gathering and that remain beyond their control during implementation. Though they cannot predict or control these complexities, designers can adapt to them when they arise, thereby guiding the emergence of new practices. This involves leaning in to ambiguity and making sense of particular challenges in all their uniqueness, rather than relying on static rules or frameworks that too often elide complexity and oversimplify. Static frameworks no doubt have their uses, but reality has a way of catching up with us; materials often 'talk back' when our preconceived notions are poorly aligned with the situation at hand.

My notion of *sensemaking in the flesh* highlights the importance of designers being physically present for the conversations with materials that run throughout any iterative design and implementation process. Sensemaking is no matter of mere interpretation insofar as we must perceive, through our bodily senses, before we can hope to make sense of our perceptions. Noticing cues that matter involves being situated in the flow of experience. This is already implied by the common design practice of "bodystorming,"

in which design teams enact imagined services as if there were real, in order to see how they feel. For services that are already in operation, allowing ourselves to notice an experience of practice break down will often precede our opportunity to investigate and pin down particular instances and sources of material back talk.

By implication, this thesis casts a sharply critical light on efforts to apply design principles while telecommuting or through brief visits to poor communities. Insofar as good design involves sensemaking in the flesh, experiencing practice break down first-hand and encountering material back talk, it is hardly compatible with “parachuting in,” the term many international development practitioners use to describe transient visits by foreign aid workers. Human-centred rhetoric is worth very little if it is used to justify the old habit of “experts decide” in which the so called experts are not even physically present for the process of making sense of wicked problems. To go a step beyond mere critique, ‘parachuting in’ is precisely the kind of feckless and patronizing practice that a substantive conversation about human-centred design for global health equity should seek to replace with imaginative and practical alternatives. Doing so will of course require more than conceptual contributions. As I reflect on the broader arc of this thesis as a jumping off point for future research and my ongoing apprenticeship in human-centered design, I would like to resurface a theme we considered in the introduction: the interrelated yet distinct notions that emerge from studies of, from and for practice.

6.2 Future Studies Of, From, With and For

In my discussion of the three-fold practice dissertation, I introduced ways of doing ethnography of and from practice. I develop this distinction further in subsequent papers, particularly with Chapter Four’s study of sensemaking in the flesh. The studies of practice that I consider in this dissertation draw explicitly on practice theory or practice philosophy. While they typically involve fieldwork, they will not necessarily involve the kind of fieldwork that is predicated on performing the phenomenon of study; they may instead emphasize “shadowing.” Studies from practice treat the ethnographer’s body as font of sociological acumen, taking the kind of apprenticeship that cultivates and employs bodily skills as a remarkable opportunity to learn.

While this approach holds potential to reveal tacit and visceral features of lived experience, my education at Cambridge has left me increasingly aware of the directional quality of studies from practice. Writing up a view from practice quite often means having left practice, re-inhabited the scholarly world and re-oriented to disciplinary theoretical concerns, never again to be immersed in or correspond with that particular world of practice. I find this even in my own writing: Chapter Four, meticulously formatted to foreground contributions to learning that will be recognized as credible in journals such as *Administrative Science Quarterly*, shows little trace of my ongoing apprenticeship in human-centred design and hope that this study of sensemaking will somehow serve as a resource for it. All too easily studies from practice leave us with similar dilemmas as studies of practice, unmoored and unsatisfied in the hope of seeming credible, legitimate or relevant for practitioners who address matters of real human concern.

As I reflect on the broader arc of my scholarship and my ongoing apprenticeship in human-centred design, there is something apparent in my experience of the global health movement which I have not yet managed to surface in my research. My line of thinking is evoked in this passage of Dorothy Smith's call for a sociology for people:

*This book spells out what I have learned from working through an attempt to make a sociology from what I experienced as, and have argued over the years is, a deep opposition between the mainstream sociology I had learned as a graduate student at the University of California at Berkeley and what I had discovered in the women's movement... It has to be a sociology **for** people, as contrasted with the sociology in which I was so properly educated, the sociology in which people were the objects, they whose behavior was to be explained. This book explicates institutional ethnography as a sociology that translates that concept into a method of inquiry. To write a sociology from people's standpoint as contrasted with a standpoint in a theory-governed discourse does not mean writing a popular sociology. The work of discovery sometimes calls for research that is technical and conceptually outside the everyday language of experience; at the same time, it has been our experience that once the institutional ethnography is completed, it becomes a resource that can be translated into people's everyday work knowledge. Hence it becomes a means of expanding people's own knowledge rather than substituting the expert's knowledge for our own (Smith, 2005, p. 1, bold indicates italics in original).*

This statement comes closer to describing my aspiration in Chapter Five (though that chapter, far from reporting on original fieldwork, contributes only a modest measure of literature review and commentary). The challenge for such studies, if they

are to yield contributions to learning that may be accepted by fellow researchers, is to produce resources for people's everyday work knowledge without falling into a vapid or boorish popular sociology. If we consider the lesson from Smith's ground breaking and highly cited approach, the key may lie in integrating studies of practice (informed by practice theory, in her case phenomenology in particular) and for practice with a perspective from practice. Elucidating the standpoint of women has been the hallmark of Smith's writing since her early work in *The Everyday World as Problematic: A Feminist Sociology* (1987). Today institutional ethnography is practiced as a sociology from the standpoint of non-experts; while this feminist sociology has opened up to consider the standpoints of men, the focus on the standpoints of typically less powerful actors in society is as central as ever. I believe this treatment of standpoint has afforded work in this tradition a distinctive kind of legitimacy, not unlike that of Wacquant's (2004; 2015) apprenticeship-based studies from practice or the rise of the physician-anthropologist perspective in medical anthropology (Farmer 2004; Holmes 2013). Such work casts a critical light on any formal sociological theorizing which elides these standpoints. It provides a basis for defending one's theories from attacks by other theorists (recall the neo-Lakatosian sociology of scientific knowledge discussed in Chapter One).

Unlike Wacquant and most organizational ethnographers, but similarly to the physician-anthropologists, practitioners of institutional ethnography do not leave this standpoint behind when they finish fieldwork and begin writing. In the manner that they produce knowledge for practice, they remain with the standpoint they have conducted their fieldwork from, at least partially immersed in the concerns of that life world. This approach is quite different from the sort of popular sociology one typically expects to find in a Harvard Business Review article, which may be based on a study of practice that was subsequently "dumbed down" (to use the all too common pejorative language) to make it accessible for mere practitioners. In the final section of this dissertation, I would like to sketch an opportunity for future research that builds on the studies of sensemaking and human-centred design presented here, while foregrounding the standpoint of people involved in the social movement for global health equity.

6.3 Countering Failures of Imagination in Global Health and Development

Global health is an attitude. It is a way of looking at the world. It is about the universal nature of our human predicament. It is a statement about our commitment to health as a fundamental quality of liberty and equity. –Richard Horton, editor of The Lancet, quoted in Reimagining Global Health (Farmer, Kim, Kleinman & Basilio, 2013, p. xv).

If you want to understand what a science is you should look in the first instance not at its theories or its findings, and certainly not what its apologists say about it; you should look at what the practitioners of it do. –Clifford Geertz, quoted in Tales of the Field (Van Maanen, 2011, p. 73)

In perhaps the most iconic pairing of images known in the in the social movement for global health equity, Joseph Jeune is pictured on the left as an emaciated near-to-death figure, having just arrived at a Partners in Health hospital in Haiti where he was diagnosed with HIV and Tuberculosis. In 1998 the average cost of one year's supply of HIV medications was over \$18,000, a price that global policy makers could not imagine paying to save the lives of poor people in foreign countries. In the bureaucracies of international development, the view that HIV treatment was not cost-effective was conflated with the idea that it was practically impossible. Andre Natsios, who led the United States Agency for International Development in those years, was quoted as saying that Africans "don't know what Western time is. You have to take these [AIDS] drugs a certain number of hours each day, or they don't work. Many people in Africa have never seen a clock or a watch their entire lives. And if you say 'one o'clock in the afternoon,' they do not know what you are talking about."⁴¹

⁴¹ This quote, the photograph and more details about Joseph Jeune's story can be found on the Partners in Health website, in a post commemorating him after his death in 2015. Retrieved from <http://www.pih.org/blog/remembering-ti-joseph-patient-friend-and-hiv-advocate>.

Figure 6.1: Joseph Jeune, a Haitian peasant, before and after treatment for HIV and Tuberculosis



At the time Jim Kim, a Partners in Health co-founder who now leads the World Bank, had recently taken a leadership position in the World Health Organization's response to HIV. With Jeune's permission these images were included in the 2003 World Health Report and, as a review of this story on the Partners in Health website puts it:

That's how Jeune, a peasant farmer and shoe shiner from a tiny village in Haiti, became the face of the WHO's roughly \$5 billion "3 by 5 Initiative." His before-and-after pictures were printed side-by-side on all manner of promotional materials, including pamphlets, which the WHO sent to ministries of health everywhere from Russia to South Africa, and Haiti to Indonesia.

The before-and-after images were a stark reminder of the horrors of HIV and the hope of treatment. In the early 2000s, a nascent global health community was forming and becoming a social movement. Applying political pressure to politicians in wealthy countries, the movement increasingly changed the political calculus for global health funding and international enforcement of HIV drug patents. The eventual result was that "the lowest available annual per-patient price of the most common first-line HAART [HIV treatment] regimen in the developing world fell from \$10,000–\$15,000 in the late 1990s to \$300 in 2002 and to \$87 in 2007" (Messac & Prabhu, 2013, p. 85).

In light of this success, Joseph Jeune's photos became a rhetorical device that activists used to critique the "failure of imagination" of mainstream global health and development practitioners who had regarded HIV treatment in poor countries as

inconceivable. With the passage of years, failure of imagination itself became a term of art in some circles, used to critique more or less explicit views that some standard of care could not conceivably be extended to the world's poorest and most marginalized communities. When I and a small group of co-workers were starting Medic Mobile in 2009, the stories of Joseph Jeune and Partners In Health were the backdrop and fire of our health-as-a-human-right activist-orientation. For us, the widespread view that cash strapped health systems could not be expected to divert money away from drugs, staff etc. to pay for digital innovation seemed like yet another failure of imagination. We set out to counter it through pragmatic demonstration projects. In the space of a few years we showed that equipping health workers with digital tools can make them remarkably more efficient, ultimately achieving better value for money for the health system, not to mention better care.

This critique of failures of imagination is what we might call an indigenous concern for members of the global health field who identify with a social movement for health equity. When I began my studies at the University of Cambridge I already saw failures of imagination as an organized, bureaucratic phenomenon, but I saw no obvious means of relating such affective and values-laden concerns to organization studies or information systems as academic disciplines.

Nonetheless I began seeking conceptual resources that would enable me to reflect critically on what exactly we practitioners were doing when we were claiming to counter or address failures of imagination. It would be simplistic to represent this phenomenon in a manner that stripped away the moral tone that is so apparent in the Richard Horton quote above. And yet, I was not interested in simply reporting what the apologists say of global health equity. In keeping with the Geertz quote above, I wanted to do fieldwork that would ground a more empirical view of what practitioners are actually doing when they are countering failures of imagination. I have not yet managed to explore this concern thoroughly, but I see this dissertation as a conceptual scaffolding through I might do so in my next major study. To my knowledge this notion has not been explored at length in the context of global health research; it remains more a matter of corridor talk and graduation speeches (Farmer, 2013). However, it has seen some consideration in organization studies and in peace studies.

In a provocative and in my view underappreciated essay based on the 9/11 Commission Report, Karl Weick (2005) offers reflections on that report's discussion of failures of imagination. The report observes that "imagination is not a gift usually associated with bureaucracies... it is therefore crucial to find a way of routinizing, even bureaucratizing the exercise of imagination. Doing so requires more than finding an expert who can imagine that aircraft could be used as weapons" (Weick, 2005, p. 425). Drawing on his own prior work, much of which I have engaged throughout this dissertation, Weick warns that "it is easy to lose sight of the fact that imagination is empirically anchored" (2005, p. 427) and argues that the workings of imagination in organizations are "similar to the workings of people in general when they engage in sensemaking" (2005, p. 429). He elaborates as follows:

To counteract failures of imagination is to alter organizing in ways that reduce the demands for coordination, replace deductive thinking with abductive thinking, shift a culture of analysis toward a culture of imagination, and intensify norms of mindfulness. These may seem like odd ways to organize. The wisdom of these actions lies in their alignment with changing contexts that are not of our own making. But this alignment does not mean that we give up stability. Instead, these design choices focus on the stable processes of labelling, connecting and action. They focus the activity of organizational design on sensemaking rather than decision making.

As with much of Weick's provocative work, this piece relies on archival material rather than fieldwork. Moreover, his concern with anti-terrorism efforts is in many respects remote from the scenes of global health care in which I intend to pursue further study. Nonetheless Weick's article suggests a conceptual path worth exploring through future fieldwork, one which might link failures of imagination and efforts to address them to organizational sensemaking and the practice of human-centred design. Insofar as these efforts are characterized by the affective and moral tone we see in the iconic images of Joseph Jeune and the quote from Richard Horton above, the study of how global health practitioners contend with failures of imagination might also be framed as an exploration of their moral imagination. The term moral imagination has received cursory attention in the participatory design literature (Robertson & Wagner, 2012), and some more sustained consideration in peace studies (Lederach, 2005). However, existing work approaches this topic from different theoretical and methodological perspectives than those advanced in this dissertation. In this sense this dissertation provides a

nuanced and novel framework for future fieldwork and writing about the complex task of organizing for moral imagination in a digital age.

6.4 References

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7 APPENDICES

APPENDIX I: CAMBRIDGE JUDGE BUSINESS SCHOOL DEGREE COMMITTEE POLICY ON PAPER-BASED FORMAT DISSERTATIONS

Pages 88-90 of the 2016-2017 PhD Student Handbook

Increasingly many faculties in the University and many excellent business schools around the world have come to accept a PhD thesis format that consists of several individual papers as an alternative to writing-up the results of three years' PhD research in a book format. The paper-based format reflects, to some extent, the "three-practicum dissertation" which, as used in Chemistry, must demonstrate the ability of a candidate to identify, analyse and solve important research problems.

This format is particularly relevant for business school placement as it supports the development of a "job market paper", which is the best individual paper and will be the basis for job applications and presentations at interviews.

Conventional format

The conventional PhD thesis has (typically) the following elements:

1. Introduction and outline of the problem
2. Literature review of subject area
3. Background to study population or area
4. Methodological chapter(s)
- 5-7. Results chapters (usually 2 or 3)
8. Conclusion and implications for policy and/or further research

The total number of chapters may run to about eight, and the total length may approach about 300 pages of A4 (80,000 words is the maximum allowed under our regulations).

The paper-based format is increasingly the norm at CJBS.

Under the 'paper-based' model, a PhD thesis consists of separate, publishable, papers. The papers are normally of journal article length (approximately 30 pages

double-spaced) and free standing (in the sense that each can be read and understood independently). These papers form the core of the PhD thesis. A paper may be accompanied by a supplementary thesis chapter that contains relevant material that could not be included in the main paper due to the space restrictions for journal papers.

Such supplementary material may include a more detailed description of the paper's data, an in-depth explanation of the methodology to facilitate replication, additional analyses or methodologies that make the paper's insights more robust and or more comprehensive or a thorough context-specific discussion of the practical implications of the research for an important problem that a specific organization wrestles with. Such chapters should follow the paper in the thesis and be indicated with the paper's name, followed by "- supplementary material".

The thesis' papers should be on related themes, so that the student portrays a coherent area of expertise to the job market. The papers are normally preceded in the thesis by a short introduction to the overall topic, which may contain essential background information and a motivation of the practical relevance of the research. There may also be a chapter with a more general literature review than is possible in a journal paper.

The number of papers in a thesis differs by discipline. The norm is three papers but some disciplines require only two, others ask for four papers. If a paper-based thesis is based on only two papers, the thesis should, in addition to the two papers, contain at least one paper-length chapter with supplementary material to one of the papers. A typical three-paper PhD thesis may look like this:

1. Introduction and background to the general topic area including a general literature review

2. First paper

3. Second paper

4. Third paper

5. Academic and managerial/policy implications of the research

The thesis should have a table of contents (if only the titles of the papers). Any appendices are commonly appendices to each paper, rather than appendices to the

thesis as a whole. All background information and literature that is relevant to a specific paper should be incorporated within this paper so that each paper can be read and understood independently. Each of the papers will contain a specific literature review and bibliography as appropriate to an academic journal article. Of course the individual papers can build on one-another and refer to one-another, as would academic journal papers, to avoid unnecessary duplication.

The Introductory chapter will set the common ground for all three papers. A good introductory chapter has the form of a critical review paper, which enables an academic reader who is interested but less familiar with the specific literature to gain an understanding of the issue under investigation and the knowledge frontier in the student's academic community. The chapter should also comment critically on the methodologies used in the literature. The introductory chapter will normally not be intended for journal publication and therefore the following papers should not refer to the introduction but have their own, more focused literature reviews. The introductory chapter will be judged by its pedagogical value in guiding the reader to the original contributions in the three papers.

The final chapter links up the results of the three papers and provides conclusions on the general implications of the research, in particular for a non-academic audience. It should also include a critical assessment of the limitations of the research and potential future research directions. The final chapter, just as the introductory chapter, must therefore be accessible to a broader audience, including managers, policy makers or indeed journalists. The emphasis of this chapter is on broad dissemination of the key thesis findings.

The total number of chapters would typically be five, and the total length would normally not exceed 200 pages of A4 (about 45,000 words). The upper limit is still 80,000 words and the lower limit is 40,000 words unless prior permission is obtained from Degree Committee.

Thus the typical 'paper-based' thesis is shorter than the conventional thesis. This has raised some concerns about the poorer quality of the work reported in this format; this however, is unwarranted. The examiners will look to each paper for sufficient depth to warrant description as a serious, analytical and original effort. Short descriptive or

insufficiently analytical papers will not meet the standards expected, even if there are a number of them. Students are strongly advised to decide on the format of the dissertation during the first year, in consultation with their Supervisor.

Time frame

Assuming three years' full-time study and a three paper thesis, as a rough guide, a student should aim to have the first paper finished within about 18 months of start, the second paper finished within 10 additional months, and the third paper finished within 8 additional months. This factors in the fact that the students will produce results more quickly as they go on, because they do not have to spend so much time cleaning data, doing background reading, and so on. It is also possible to work on the three papers in parallel.

It is unlikely that the first paper (of requisite quality) will be complete in time for the first year report, unless it is a follow-on from MPhil research. The first year report may consist of a draft of the introductory chapter, and of the first paper, with outlines of what the second and third papers will be.

Publication

The papers need not be published at the time of the submission of the PhD thesis. What is required, as a minimal hurdle, is that they be publishable in a well-regarded refereed journal, which in most subject areas would be one of the ISI-listed journals. If any of the thesis papers are published or accepted for publication, or have received an invitation to revise and resubmit from a leading journal, this will be taken by examiners to be prime facie evidence of publishability.

It would be advisable for the students to submit their papers to the working paper series as soon as they are ready. They should also be encouraged to make journal submissions when papers are ready, since they can then expect to get valuable feedback from referees who enable them to improve them before their viva, but they should not be obliged to submit any of them before the viva. If the examiners are convinced that they are publishable and constitute a substantial original contribution to the field, which has been correctly executed and well presented, then the student should get the PhD.

Joint work

On the one hand, the PhD thesis must be substantially the students' own work. On the other hand, collaborative research is encouraged by the school and the norm after the PhD. To balance these two objectives, we require that the majority of the work must be done by the student. In some disciplines it is the norm that the job market paper is single authored, in others all papers are typically co-authored. It is important that the student discusses the discipline's conventions with their supervisor during their first year.

The student should be responsible for at least 2/3 of the original contribution of the thesis. For example two 50/50 collaborations between a co-author and a student and a single authored paper would satisfy this requirement. Students are strongly advised to agree the level of contribution with their co-authors at the start of each project.

In practice this means that the student has to be principal author on all papers that are part of the PhD thesis. Either first-named author in non-alphabetical order Or alphabetically listed, where the co-authors confirm in writing that the student was the principal author of the paper. When co-authored papers are included in the thesis, the student has to be able to defend the paper as a whole, not just his or her contribution to the paper.

APPENDIX II: MOBILE HEALTH FOR CANCER IN LOW TO MIDDLE INCOME COUNTRIES: PRIORITIES FOR RESEARCH AND DEVELOPMENT

Holeman, I., Evans, J., Kane, D., Grant, L., Pagliari, C., & Weller, D. (2014). Mobile health for cancer in low to middle income countries: priorities for research and development. *European Journal of Cancer Care*, 23(6), 750–756.
<http://doi.org/10.1111/ecc.12250>

Many current global health opportunities have less to do with new biomedical knowledge than with the coordination and delivery of care. While basic research remains vital, the growing cancer epidemic in countries of low and middle income warrants urgent action – focusing on both research and service delivery innovation. Mobile technology can reduce costs, improve access to health services, and strengthen health systems to meet the interrelated challenges of cancer and other noncommunicable diseases. Experience has shown that even very poor and remote communities that only have basic primary health care can benefit from mobile health (or ‘mHealth’) interventions. We argue that cancer researchers and practitioners have an opportunity to leverage mHealth technologies that have successfully targeted other health conditions, rather than reinventing these tools. We call for particular attention to human centred design approaches for adapting existing technologies to suit distinctive aspects of cancer care and to align delivery with local context – and we make a number of recommendations for integrating mHealth delivery research with the work of designers, engineers and implementers in large-scale delivery programmes.

Keywords: delivery research, human centred design, global health, mHealth, service delivery innovation, developing countries, cancer, community health workers, low income countries, innovation, mobile health, technology, service delivery, primary care, eHealth.

APPENDIX III: DIGITAL TECHNOLOGY FOR HEALTH SECTOR GOVERNANCE IN LOW AND MIDDLE INCOME COUNTRIES: A SCOPING REVIEW

Holeman, I., Cookson, T. P., & Pagliari, C. (2016). Digital technology for health sector governance in low and middle income countries: a scoping review. *Journal of Global Health*, 6(2), 1–11. <http://doi.org/10.7189/jogh.06.020408>

Background Poor governance impedes the provision of equitable and cost-effective health care in many low- and middle-income countries (LMICs). Although systemic problems such as corruption and inefficiency have been characterized as intractable, “good governance” interventions that promote transparency, accountability and public participation have yielded encouraging results. Mobile phones and other Information and Communication Technologies (ICTs) are beginning to play a role in these interventions, but little is known about their use and effects in the context of LMIC health care.

Methods Multi-stage scoping review: Research questions and scope were refined through a landscape scan of relevant implementation activities and by analyzing related concepts in the literature. Relevant studies were identified through iterative Internet searches (Google, Google Scholar), a systematic search of academic databases (PubMed, Web of Science), social media crowdsourcing (targeted LinkedIn and Twitter appeals) and reading reference lists and websites of relevant organizations. Parallel expert interviews helped to verify concepts and emerging findings and identified additional studies for inclusion. Results were charted, analyzed thematically and summarized.

Results We identified 34 articles from a wide range of disciplines and sectors, including 17 published research articles and 17 grey literature reports. Analysis of these articles revealed 15 distinct ways of using ICTs for good governance activities in LMIC health care. These use cases clustered into four conceptual categories: 1) gathering and verifying information on services to improve transparency and audit-ability 2) aggregating and visualizing data to aid communication and decision making 3) mobilizing citizens in reporting poor practices to improve accountability and quality and 4) automating and auditing processes to prevent fraud. Despite a considerable amount of implementation activity, we identified little formal evaluative research.

Conclusion Innovative digital approaches are increasingly being used to facilitate good governance in the health sectors of LMICs but evidence of their effectiveness is still limited. More empirical studies are needed to measure concrete impacts, document mechanisms of action, and elucidate the political and sociotechnical dynamics that make designing and implementing ICTs for good governance so complex. Many digital good governance interventions are driven by an assumption that transparency alone will effect change; however responsive feedback mechanisms are also likely to be necessary.

APPENDIX IV: DESIGN AND IMPLEMENTATION OF AN OPEN SOURCE “THIN SIM” SYSTEM FOR COLLECTING DATA & SUPPORTING GLOBAL HEALTH CARE

Holeman, I., Yembrick, A., Brown, D., Kane, D., Katanu, J., Abbyad, M., & Sharma, R. (2016). Design and Implementation of an Open Source “Thin SIM” System for Collecting Data & Supporting Global Health Care (pp. 1–10). Presented at the Proceedings of the 7th ACM Symposium on Computing for Development. <http://doi.org/10.1145/3001913.3001923>

Cutting edge communication technologies such as smartphones remain far from prevalent in most of the settings with the greatest need for improved health and development programs. As a result, designers of ICT4D initiatives often weigh difficult tradeoffs between the usability of smartphone applications for structured data collection versus the battery life, durability, cost and familiarity of basic phones. However, as this paper and our deployment experiences demonstrate, such tradeoffs are not always necessary. Most mobile network operators in sub-Saharan Africa offer value added services via simple, menu-driven applications that run directly from the SIM card. While conventional SIM applications can only be accessed by mobile network operators, this paper describes the design and implementation of a ‘thin SIM’ approach that does not require mobile network operator involvement. We have implemented this tool with more than 3,000 health workers and describe particular deployment experiences in Kenya, Benin, Nepal and Guatemala. We then reflect on a number of important limitations of the thin SIM approach, and opportunities for further development and deployment. Ultimately, we argue that there is an important role for SIM applications as one part of a configurable data collection toolkit for supporting global health and development programs.

Keywords: ICT4D; data collection systems; global health; mHealth; SIM card; SIM applications, SIM Tool Kit (STK)